NATURE

No. 3858 SATURDAY, OCT. 9, 1943 Vol. 152

CONTENTS

	Page
Educational Reconstruction : General Review	393
Mice and Men. By M. A. C. Hinton, F.R.S.	395
Logical Empiricism. By Prof. Herbert Dingle	397
Science and Industry of Plastics	398
Principles of Insecticidal Bio-assay. By Dr. H. Hurst	400
The Biological Section of the Ukrainian Academy of Sciences. By Nikolai Grishko	404
Obituaries :	
Lady Lockyer. By Sir Richard Gregory, Bart., F.R.S.	405
Mrs. Thoday. By Prof. F. E. Weiss, F.R.S.	406
Dr. H. G. Baynes. By John Layard	406
Dr. L. F. Barker. By Dr. J. D. Rolleston	407
Dr. H. C. H. Townend	407
News and Views	408
Letters to the Editors :	
Interpretation of Patterson Diagrams.—Prof. J. Monteath Robertson	411
A New Criterion for Expressing the 'Intensity of Firmness' of Soft Bodies.—Dr. G. W. Scott Blair	412
Structure of the Eta Phase of the Iron-Silicon System.—Madame A. R. Weill	413
Variation of Serum Composition with the Age of Horses as shown by Electrophoresis.—Dr. Alfred Polson	413
A New Source of Trehalose.—Dr. J. Leibowitz	414
Microbiological Assay of Riboflavin.—Dr. Frank C. Happold ; Dr. E. Barton-Wright and R. Gordon Booth	414
An Alumina Hydrogel.—F. C. Johnson	415
Production of Freshwater Fish in Palestine.—C. K. Ricardo Bertram	415
Polyploidy in the Potato.—Prof. R. Ruggles Gates, F.R.S.	416
Apparent Reversal of Position of the Golgi Element in the Renal Tubule.—Major J. F. A. McManus	417
Competition for Nitrogen between the Take-all Fungus and the Roots of Crop Plants.—S. D. Garrett	417
Vacuum Filtration of Sewage Sludge.—J. H. Garner	418
Nutritional Research in the Crown Colonies.—D. Fitzgerald Moore	418
James Prescott Joule and the Unit of Energy.—A. W. V. Mace ; Graham Renshaw	418
Research Items	419
The Plane Tree. By Alexander L. Howard	421
Science and the War Effort	422
Clinical Photography	423
Rehabilitation of the 'Scorched Earth' in the U.S.S.R.	424
Lightning Protection of Buried Cable	424
Plant Diseases	425

Editorial and Publishing Offices
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number : Whitehall 8831
Telegrams : Phusis Lesquare London

Advertisements should be addressed to
T. G. Scott & Son, Ltd., Talbot House, 9 Arundel Street, London, W.C.2
Telephone : Temple Bar 1942

The annual subscription rate is £4 10 0, payable in advance, Inland or Abroad.

All rights reserved.

Registered as a Newspaper at the General Post Office

EDUCATIONAL RECONSTRUCTION

GENERAL REVIEW

IN NATURE of July 31 we published an article bearing the above title, and arising immediately out of the White Paper which had been presented to Parliament by the President of the Board of Education. The article was in the main expository and explanatory, further comment being expressly reserved for a later date. On the present occasion we give a general account of the situation as seen after some months of discussion in the country, and in following issues we hope to discuss special aspects of the comprehensive contents of the White Paper.

For a comparable effort to deal with education on a national scale, we have to go back to the year 1870, when W. E. Forster took the lead in the passing of the first Elementary Education Act. His declared object was to complete the existing voluntary system and to "fill up the gaps". His Bill was well received, but second thoughts on the part of his own political associates proved disastrous. As one turns over the pages of Hansard, one marvels at the melancholy tale of denominational jealousies and suspicions, and even though the lapse of seven decades has softened asperities, one is impressed with the wisdom of Mr. Butler's patient and cautious method of approach. The stern warning was repeated in 1902, when Balfour's measure established rate-aid for voluntary schools and along with it the dual system of control—opposed with all the bitterness of 1870, and still, as the White Paper shows, the chief stumbling-block in the path of the reformer. The other outstanding measure, that of 1918, conceived in a very different atmosphere, and at first supported with enthusiasm, remains to this day in great part a dead letter, as regards its socially significant provisions, namely, those relating to youth and to nursery schools. No wonder that, with this premonitory instance plain to be seen, the "exceeding lack of speed" in the proposals of the White Paper should have alarmed many of the firmest friends of education. They quite agree with the White Paper that laws cannot do everything, that laws "cannot build better human beings", and that "it is not the machinery of education so much as its content that will count in the future" ; but they remember also that the law's delays can do an infinite deal of harm. There is little doubt that we shall hear more of this when the Education Bill comes before Parliament.

From the broadly national point of view taken in this article, the most far-reaching statement in the White Paper appears unobtrusively and almost incidentally in paragraph 27 : "The key-note of the new system will be that the child is the centre of education and that, so far as is humanly possible, all children shall receive the type of education for which they are best adapted". The child the centre of education ! Of course no originality is claimed for this declaration. That the child is the true and only centre of education has for centuries been the merest commonplace in the best educational thought. Nor

can it be claimed that it now appears for the first time in an official document, for it was the key-note also of Morant's famous introduction to the Code of 1904. Through his instrumentality, the child, not the official nor the tax-payer, nor even the teacher, was for the first time envisaged as the central figure in the educational scene, for whom, and for whom alone, that scene exists. The late Sir John Adams used to say that you had to hammer away for at least fifty years to secure a reform before anyone even began to listen; and was it not the late Lord Balfour who said that democracy must be led, not driven, but that it takes a lot of leading? When, however, democracy has made up its mind, the thing is done, and done far better than as the result of an autocratic decree. Let us hope that on this point our democracy has at last made up its mind.

Most of what follows will be in the nature of corollaries to this basic proposition. Large classes, for example, are condemned on the fundamental ground that they are bad for the child. "No teacher, however competent, can see to the development of an individual child's innate potentialities, or foster in it a healthy development of mind, body and character, if she has to deal single-handed with a class of 50 small children. This is not education but mass production" (par. 16). Large classes are always and necessarily bad for the child, though not obviously so for the teacher. For there is a type of teacher who can quite as easily manage fifty children as a dozen, and may indeed be happier with the fifty. But though he may please a superficially observant inspector or other visitor, he is not a good type of teacher, for the simple reason that he is satisfied with mass production. Large classes make it impossible for *any* teacher to meet the needs of the individual child—and that settles the matter.

The formula seven-to-eleven as the period to be spent in the junior school may commend itself to a person who surveys the educational scene from an office window. But it is in reality nothing but an administrative convenience. No scientific student of child nature, and indeed no close observer whatever, could approve of such a denial of the fact of individuality. Furthermore, the institution of an examinational test at the age of ten or eleven has had disastrous effects upon the aims and methods of the junior school, especially where competition for admission to secondary schools has been keen. Again, the White Paper takes the child's point of view, not that of the administrative machine—and the competitive examination goes. So also does the absurd assumption that any child's future development can by any imaginable means be safely foretold at the age of ten or eleven.

We have not observed that the proposed abolition of the examination at or before the age of eleven has called forth any lamentations. That is not quite true of the Norwood Committee's recommendation that the purely external examination for the school certificate should, "in the interest of the individual child and of the increased freedom and responsibility of the teaching profession", be gradually modified out of existence. Nothing could in point of fairness be better than the Committee's statement of the *pros* and *cons*, but its verdict is emphatic. Much of the opposition seems to have come from the men teachers, who are commendably anxious for the reputation of the certificate. The arguments employed are strongly reminiscent of the controversy which led to the present position in the University of London. Those arguments have in them a flavour of the nineteenth century, when the external examiner held universal sway, from the lowest to the highest of educational institutions. Let it be noted that the Committee's recommendation is in perfect accord with the White Paper. It is based upon "the interest of the individual child". The addition "and the increased freedom and responsibility of the teaching profession" is at bottom only another way of saying the same thing.

Coming now to the inevitable "religious difficulty", we note that in some quarters disappointment is expressed that the dual system of control is to be allowed to survive. For ourselves, we strongly suspect that if the matter could be left to the teachers and parents there would soon be an end of the difficulty. But we recognize that the whole history of our educational past is against that solution, and we can no more get away from that past than a man can get away from his own shadow. We are therefore left to admire the tact and patience with which Mr. Butler has handled his thorniest problem, and to express the hope that the intransigents, both of the Left and of the Right, may on this occasion sing small—again for the sake of the children of England. We observe also that many teachers are not so sure of the agreed syllabus being a sovereign remedy as the White Paper appears to assume. They reasonably point to the Board of Education's practice of issuing *suggestions* on the teaching of various subjects, a practice which is highly valued by the teachers, and they say that if an agreed syllabus is put forward as a suggestion rather than a mandate it would also be welcome. We are inclined to think that that is precisely the way in which an agreed syllabus will be viewed and utilized by a thoughtful teacher, who will reserve to himself a certain liberty of interpretation. The teacher may, we think, safely accept the agreed syllabus as representing at any rate "the next step".

The new system, the child-centred system, of which the White Paper speaks, falls into three stages—primary, secondary, and further education. To begin at the beginning, the nursery-school movement is excellent so far as it now goes. It is the outcome of the wisdom and enthusiasm of such persons as the McMillan sisters. The quality is there, but as to the quantity, nearly everything remains to be done, and there is no social problem more urgent. The proper aims of the primary school are well set forth in the Paper, but we are faced with the fact that even in places where re-organization has been arranged, the primaries are too often housed in buildings that make those aims impossible to realize. As for the secondary stage, the grammar schools, of course, we have with us, with their good record of achievement during the

past twenty years, predominantly on academic lines. That those lines now need radical revision is strongly urged by critics who are by no means lacking in respect for tradition. They value the Norwood Report for its enunciation of principles, but contend that those principles are not carried to their logical conclusion in the recommendations as to curricula. Preparation for post-war citizenship calls, as we have said, for radical revision, but the Norwood Report tacitly asserts that the old bottles are safe containers of the new wine. This will never do. As for the modern schools, the White Paper waxes almost lyrical in describing their possibilities, and it is well to have the ideal set forth in an official document which has secured general approval. But the drab reality is that in respect of buildings, equipment, staff and 'amenities' nearly everything remains to be done.

We recite these examples, to which others may be added in subsequent articles, not indeed as a counsel of despair, but rather as an explanation of the deep concern expressed by educationists at the "excessive lack of speed" which the White Paper seems to view with complacency. Seeing that, for example, the intended raising of the leaving age and the progressive reduction of large classes depend upon the supply and training of teachers, the Board should take immediate steps, whatever the findings of the McNair Committee may turn out to be. The postponement of the reform of the dual system is held by experienced administrators to be quite unjustified by the facts. The omission of adult education from the first four-year plan is held to be unnecessary, seeing that much of it does not involve great outlay upon buildings and equipment. Finally, the case for forging straight ahead in the provision of nursery schools is, having regard to their social value both now and hereafter, quite unanswerable.

There are other problems arising out of the Paper which are not so urgent, but which are scarcely likely to be forgotten in parliamentary debates on the Bill. The reference to "public schools and other analogous schools" (paragraph 8) is one of them. In any discussion of the English public schools it is hard to disentangle reason and sentiment. However, two facts stand out clearly: (1) they have no counterparts in any other democratic country, and (2) though they are so few among so many, yet about three out of four of all the high offices of State and Church are filled by their products. Defenders of the public schools aver that if the schools produce leaders it is because of their intrinsic merits and nothing else. At this point the arguments begin to sway to and fro. If it be said that the basis of public school education is Christian, proof is demanded that the public school product is more markedly Christian than the county school product. If the defender of the public school says that it is independent of any other authority, he is asked whether standing aloof from the national system is really claimed as a merit. If he says that the headmaster has the power of what the Americans call 'hiring and firing', he is asked whether that is the kind of authority which should be vested in any one person. If he asserts that the child belongs to the parents and not to the State, and that parents have the right, by payment of fees, to choice and voice in their children's education, he is asked whether the parents who cannot pay fees thereby resign their rights to the State. And so the arguments succeed one another in a sort of ding-dong iteration. Probably the intelligent man-in-the-street, now that the full light of day is being cast on the situation, will find it hard to believe that the arguments produced are sufficient to explain the facts with which we started. Let us always remember, too, that most of the men and many of the women who will have to decide such issues are now scattered all over the world, and that post-war England may make short work of some of our hitherto accepted and uncriticized traditions.

Such are some of our second thoughts on the White Paper. The parliamentary discussion of its contents was interesting, appreciative and, on the whole, only mildly critical. When the Education Bill appears, the second thoughts of our legislators will resound through the land. It is to be hoped that both in its passage through Parliament, and in its subsequent translation into administrative action, it will fare better than its predecessors of 1870, 1902, and 1918.

MICE AND MEN

Voles, Mice and Lemmings

Problems in Population Dynamics. By Charles Elton. Pp. vii+496. (Oxford: Clarendon Press; London: Oxford University Press, 1942.) 30*s*. net.

IN his preface, Dr. Elton tells us that: "The materials of this book have been assembled slowly for sixteen years. . . . The first part is a panorama of vole and mouse plagues in those countries for which records are available. The second part describes the vole and mouse fluctuations that occur in Great Britain and Scandinavia, and the methods developed at Oxford for the study of population dynamics in the field and laboratory. The third and fourth parts contain the history of similar fluctuations in Northern Labrador and Ungava that have an important influence upon the fur trade and the life of the natives." It may be said at once that the book is a great magazine of facts, a witness to the vast amount of useful work that has already been accomplished by Dr. Elton and his colleagues in the Bureau of Animal Population at Oxford, and it is enlivened by many a bright flash from the author. Nevertheless, it is not an easy book to review. The first two parts are excellent. But the reviewer feels, after reading them with great attention, that Parts 3 and 4 want pulling together; it would be worth while coaxing Dr. Elton later on, when he has forgotten the details and the archives of the Hudson's Bay Company and the Moravian missions, to write a little essay on this part of his subject.

Part 1, "Vole and Mouse Plagues", contains six chapters, of which the first, entitled "Ancient History and a Prophecy", is very fine. It opens with an account of Gérard's description of field-mouse plagues in Alsace during the six hundred years between 1271 and 1861 and directs attention to the

immense literature of the subject. Dr. Elton says: "To comprehend the history of European mouse plagues one has to read, among other and less peculiar works, a fauna of Alsace by a French notary [Gérard]; a vole plague report by a learned Indian civil servant and oriental scholar [Elliott] who retired to become a landowner in Scotland; a folk-lore essay written by a classical scholar and head of an Oxford college [Powell]; a painstaking collection of classical references about animals by a school-teacher in Germany [Lenz]; and part of the works of Aristotle"—together with the Vulgate and English Bible cited by the author in his next paragraph. He says: "In spite of sweeping changes in God and circumstances, Authority has for several thousand years continued to act in much the same way, even to the present day. The Bible story is, if you like, a parable. The affair runs always along a similar course. Voles multiply. Destruction reigns. There is dismay, followed by outcry, and demands to Authority. Authority remembers its experts or appoints some; they ought to know. The experts advise a Cure. The Cure can be almost anything: golden mice, holy water from Mecca, a Government Commission, a culture of bacteria, poison, prayers denunciatory or tactful, a new god, a trap, a Pied Piper. The Cures have only one thing in common: with a little patience *they always work*. They have never been known entirely to fail. Likewise they have never been known to prevent the next outbreak. For the cycle of abundance and scarcity has a rhythm of its own, and the Cures are applied just when the plague of voles is going to abate through its own loss of momentum". In passing we may note that drastic cures sometimes prolong the ill; some years ago a group of tiny but valuable islands, in a Scottish loch, were devastated by water-voles, which resisted attack by keepers, dogs, traps and poison for many months. At last an expert, too lazy to need naming, was consulted; observing (to his relief) that the voles, for all their sleek appearance, were just living bags of pus, he fearlessly told the owner to close the islands and let the plague rip. The advice was taken and in a short time the voles disappeared, the grass grew again and the islands once more became good grazing.

In the remaining five chapters of Part 1 Dr. Elton reviews the history of vole and mouse plague in France, Germany, Holland, Italy, the Balkans, Russia, Palestine, Australia, the United States and Canada. He describes the efforts made by Pasteur, Loeffler, Danysz, and others to control the pests by bacteriological methods, and he gives a valuable account of Russian experience and research. He also develops the theme that the chief biological interest of "mouse-plague" centres in the periodicity of the fluctuations in the rodent population, and dealing with work done in the United States directs attention to the researches of Hamilton, who asserted that "it was possible to forecast high populations of mice 18 months before their appearance, while the mouse population was far from numerous. Following extensive warnings and suggested field practices 1½ years prior to the outbreak, orchardists were able to safeguard their trees in part from the most severe mouse infestation New York has ever experienced."

In Part 2 (pp. 126–233) Dr. Elton deals with the fluctuations in north-west Europe. He opens (Chapter 7) with a fine account of the Scottish vole-plagues of 1875–76 and 1891–92, which were remarkable not only for their severity but also for their location on the hills used for sheep-grazing. Sheep create conditions which are not favourable to undue increases in the vole population; whereas forest planting, for a time, favours the voles, grass growing luxuriantly in the plantations and affording abundant cover and food. We would remark in passing that voles, particularly species of Microtus, of which one was the species chiefly concerned in these plagues, are creatures of the open country and not of the forests; although they find convenient stations for recuperation at the edges of woods and in young plantations, sooner or later, when their numbers rise to a peak, they must swarm out into the open ground—sheep or no sheep. Winding up his account of these plagues and what was done to control them, Dr. Elton says: "In the impressive march of this outbreak we have seen a common but not extremely abundant inhabitant of the south Scottish hills increase suddenly within a year or two up to the absolute limit of subsistence, partially eliminating its chief competitor (the sheep), attracting to the area and maintaining for a short while a cloud of predatory birds, and giving also a feast for ground predators. Then its population subsides and leaves the predators in turn without subsistence. The grass recovers quickly and gives one of the best crops the shepherds have known."

In Chapters 8 and 9 an account is given of British research on the population dynamics of voles and mice between 1923 and 1939, that is of the work done by Dr. Elton and his associates in the Bureau of Animal Population at Oxford. Collett's account of the Norwegian lemming and its migrations and some of the fur returns of the Hudson's Bay Company cited by Gordon Hewitt were the sources from which Elton first gained the impression that rodent populations are subject to periodical fluctuations which occur quite independently of any variations (sometimes large) resulting from human interference. Later he found that this idea had been propounded, with characteristic insight, by Herbert Spencer in his "First Principles" so far back as 1863. It became the work of the Bureau to devise and to apply means and methods of testing this idea both in the study and in the field. The vast literature and the records of the Hudson's Bay Company and those of the Moravian missions were ransacked; field observations, including attempts to take at intervals a census of rodents and studies of their enemies in as many parts of the country as possible, were instituted on a large scale; and a long course of breeding and feeding experiments, together with a good deal of pathological and bacteriological research, was undertaken at Oxford.

In these ways much has been done already at the Bureau of Animal Population; but a great deal more remains to do. The problems involved have shown themselves to be subtle and of a far-reaching importance, which will tend to increase as the exploitation of 'backward' countries advances. Any detached philosopher, capable of taking one of those broad views in depth so cordially detested by statesmen and traders in all countries, will have little difficulty, after perusing this book and Lankester's "Kingdom of Man", in concluding that a world-wide biological service is one of the world's greatest needs, current disturbances notwithstanding. Such a service needs not only the co-operation of ecologists, systematists, and other scientific workers in all countries, but also public support. That can only be obtained from an educated public; and this education can best be

given to the public by the museums, menageries and botanic gardens of the world. In all these institutions, to a degree varying with the character of each, attempts to bring the living world before the common man, to show the close interrelations of the fauna with the flora and of all their elements with one another, should be made by means of special exhibitions, lectures and publications. It is no longer enough to show the bare bones of systematics.

Meanwhile it is depressing to read of Dr. Elton's struggles to obtain financial support for the Bureau (p. 160). Participation in its work "usually involved a high personal risk to the continued livelihood of some or all of the members", leading naturally to undesirably frequent changes of personnel. "The search for money entailed a fantastic waste of energy and has slowly developed a skill in negotiations which can bear only an accidental relation to the real scientific value of a particular project." It is surely unworthy of a great country, with such vast interests in world agriculture, commerce, development, and the public health, to allow the Bureau to depend upon begging for its existence. So long as it does such work as is described in the present book, it will merit support from the State. The interest of the University of Oxford in the work of the Bureau is naturally more limited. Appeals to the world of commerce have been not unsuccessful; but commercial men are apt to have their own pet problems for solution and financial help from them too often deflects the man of science from his true goal.

Chapter 10 deals with Scandinavian lemmings and completes Part 2. Parts 3 and 4 are devoted to the periodical fluctuations in foxes, mice and lemmings, caribou and related creatures, including man, in Labrador and Ungava. Based largely on the records of the Hudson's Bay Company and the Moravian missions, they contain much hitherto unpublished material concerning Eskimos, Red Indians, and Whites in those countries as well as the great store of zoological information which is their chief purpose.

It remains only to note that the book is very well produced and illustrated with a frontispiece, showing an eighteenth century trapper, Captain George Cartwright, visiting his traps in Labrador, and with a number of clear maps and graphs.

M. A. C. HINTON.

LOGICAL EMPIRICISM

Between Physics and Philosophy

By Philipp Frank. Pp. v+238. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1941.) 15*s*. 6*d*. net.

THE title of this book is unfortunately chosen and is definitely at variance with the italicized statement on p. 103 that "*there are no boundaries between science and philosophy*". The suggestion of a sort of no-man's-land between physics and philosophy is indeed quite out of harmony with the ideas which Prof. Frank advocates. He was one of the original members of the "Vienna Circle" of logical positivists (or, as they have later been much better called, "logical empiricists"), and his book is particularly valuable for the authoritative account it gives of the origin and development of this school and its relations with cognate movements such as American pragmatism and the new logic of Russell and Wittgenstein. The book consists of reprinted addresses and articles extending over the period 1908–38, to which is prefixed a short historical introduction. It is clearly written, and should be read by all who are interested in the philosophical aspects of modern physics.

The main ideas of logical empiricism are now fairly well known in Great Britain, though it may be doubted whether their implications are widely understood. Perhaps the most concise statement of the most essential element of the system is given in the quotation from Carnap on p. 88: "There are no questions the answers to which are impossible for science in principle"—supplemented by the remark of Wittgenstein which follows: "When an answer cannot be expressed, neither can the question be expressed". Wittgenstein thus makes perfectly general what Carnap in this place restricts to science. Contrast with this the conjecture of Sir James Jeans that the "inner nature" of things (for example, of a centimetre) presents an essentially insoluble problem. Superficially it would seem as though Jeans had expressed an unanswerable question, but the logical empiricists would show (and here anyone who accepts the fundamental principles of science must acknowledge that they have proved their case) that he had merely written a succession of words without meaning. Obviously, to support their contention they must therefore pay special attention to the structure and function of language, and accordingly the more recent developments have been mainly in this direction. Carnap and Neurath in particular have directed investigations along these lines.

Without an appreciation of the way in which the logical empiricists have been forced to study language (and perhaps even with it) one can scarcely avoid the conclusion that they have allowed themselves to be diverted from the highway of progress in philosophy, along which they began to march, into a profitless *cul de sac*. Take, for example, the statement of the uncertainty principle (pp. 205–6). "Quantum physics says only that with certain experimental arrangements concepts like 'particle with a definite position' or 'particle with a definite velocity' can be defined. In other words, the physical processes which occur with these experimental arrangements can be predicted through statements in which one refers to 'a particle with a definite position' or 'a particle with a definite velocity', but there is no arrangement for which one can predict processes through statements involving 'a particle with a definite position *and* velocity'. This, however, does *not* mean that there are such particles, which, because of the defectiveness of our apparatus or because of malicious natural laws, we cannot measure in all their characteristics (position and velocity); it means rather that such combinations of words as 'a particle with coördinates x, y, z, and velocity v_x, v_y, v_z', must not be introduced into the language of physics". This is all very well, but why, in a free country, cannot we introduce such combinations of words if we wish? The answer in the end comes down simply to this, that we should then be led to expect experimental results (experiences) which do not occur. The language is therefore controlled by experience, and while it is, of course, essential that it should be so controlled, the insistence on a "physicalistic" as contrasted with a "phenomenalistic" language, in the interests of the unification of all science in a common language, seems to offer an easy passage to the control of experience by language.

The unification of science indeed comes perilously

near to being enthroned as a dogma instead of being pursued as an ideal. It is the aim of every man of science to include more and more experience, of every kind, in a common logical system, but he is no true man of science if he does not recognize, first, that he may be aiming at the impossible, and secondly, that he is most likely to succeed in his object if he starts with different groups of experiences and correlates them by independent concepts, using independent languages, until by the growth of knowledge they may be united into a common system. Heat and mechanics began as independent studies, speaking independent languages, and later grew into the science of thermodynamics, for which the single language of energetics is sufficient. If the concepts and terms of the caloric theory had been denied to Carnot, what would have been the state of this science now? Magnetism and electricity, radiant heat and light, chemistry and spectroscopy—examples are legion—all tell the same story; and if, as we may hope, physics, biology and psychology are potentially one science, there would be little chance of their being recognized as such if the behaviourists, armed with the dogma of the logical empiricists' "physicalistic language", succeeded in depriving the infant science of psychology of all terms and concepts which physics at present does not need.

Prof. Frank devotes some attention to the social aspects of science, dealing in particular with the relation of logical empiricism to dialectical materialism. Here he is less convincing than in the more fundamental sections of the book. He introduces some special pleading in order to establish a likeness between the two systems of thought, and is accordingly forced to ignore the most essential elements of dialectical materialism. For example, he finds (p. 149) Lenin's doctrine that propositions such as "Matter is infinitely divisible" "are never to be labeled as true or false; they are to be judged by their practical consequences" to be "very closely related" to the logical empiricists' view that "the truth of a proposition can only be judged if the methods of testing it are given". He omits to mention, however, that the "methods of testing" are utterly incompatible in the two cases, although two pages earlier he has stated that dialectical materialism "understands by test, above all, the test of a principle in social life, in revolutionary practice, as they put it". Does logical empiricism find the meaning of infinite divisibility in revolutionary practice? Again, on p. 125 it is stated that a recent tendency to find support in modern physics for philosophical idealism has "no connection with any 'crises in physics' or with any 'new physical conception of nature'. It is rather associated with a crisis in human society arising from quite different processes". This is a remarkable statement from one who holds that the truth of a proposition can only be judged if the methods of testing it are given. By what test has Prof. Frank found a connexion between Jeans's 'mathematical God', which is particularly mentioned, and a "crisis in human society"? And how has he established that the conception of that God has no connexion, not even an illogical one, with the quantum theory? It is to be feared that here Prof. Frank is neither logical nor empirical; he has used combinations of words which must not be introduced into the physicalistic language.

This, however, is a minor aspect of a book which, in the main, may be received with praise and gratitude. It is characteristic of the logical empiricists that (except in the later developments of their language analysis, which reveal everything about language except that it is intended to mean something) they express themselves clearly, unambiguously and, for the most part, convincingly. Prof. Frank has retained these qualities for thirty-five years. Let us hope that he will continue to interpret the development of one of the most significant of modern schools of philosophy.

HERBERT DINGLE.

SCIENCE AND INDUSTRY OF PLASTICS

Synthetic Resins and Allied Plastics

By Various Authors. Edited by Dr. R. S. Morrell. Second edition. Pp. xiii+580. (London: Oxford University Press, 1943.) 35s. net.

THE second edition of "Synthetic Resins and Allied Plastics", edited by R. S. Morrell, reflects the spectacular advances made in this field of applied chemistry, inasmuch as ten experts have been called on to collaborate in the production of the present volume. It is only five years ago since the first edition, compiled by four authors, made its appearance, endeavouring in one volume to cover the whole of the plastics industry from both technical and theoretical points of view. The present edition is structurally similar to the first edition, but considerably expanded to cover the progress made during the past five years. Each chapter is a condensed review of individual fields of plastics.

For the ordinary reader the introductory chapter is almost, in itself, a sufficient review of the industry and science of plastics, but the succeeding chapters on resins derived from proteins, cellulose, phenols, and urea in combination with formaldehyde, on the vinyl, acrylic and coumarone polymers, the ester gums, and finally on the alkyd and petroleum hydrocarbon resins, are exhaustive in their detail, and possibly only those intimately connected with this branch of applied science can thoroughly appreciate the vast strides made in recent years.

There are also special sections on the application of phenol and urea-formaldehyde resins as components of varnishes and enamels, and a very interesting chapter on miscellaneous resins wherein are described many plastics which command attention either on account of their mode of formation or because of their specialized application, but which have not yet been sufficiently developed to justify classification into groups. Included in this edition also are chapters on electrical tests carried out on resins and on methods of identification of resins. This latter, together with two sections on the theory of resinification, will give much food for thought and should be productive of new ideas and methods of approach in the elucidation of this problem. Finally, there are many illustrations, and each chapter is amply supported by a very comprehensive list of references to original publications.

This brief summary of the contents of the work will serve to show the wide field of readers to whom this valuable book should appeal. Not only the technician but also the more secluded research worker will find a very full account of the progress of the science of plastics, and also much theoretical information. Undoubtedly this edition will be eagerly sought after by all those interested in the science or engaged in the manufacture of modern plastics.

The Technique of Radio Design

By Dr. E. E. Zepler. Pp. xii+311. (London: Chapman and Hall, Ltd., 1943.) 21*s*. net.

THE author of this book has had a number of years experience as a radio designer in the research and development departments of two well-known commercial firms, one in Great Britain and one in Germany; and the book records much of that experience as an aid to the radio equipment engineer in dealing with his daily routine problems.

The scope of the work covers the design and basic construction of radio communication receivers of all types, and concerns intimate details of receiver work rather than a comprehensive treatment of principles, which are already adequately catered for in other publications. The first chapter, on "Some Fundamental Theoretical Facts", is preceded by a list of symbols and some useful formulæ and graphs on the inductance, capacitance and impedance of wires, coils and feeders. The succeeding chapters then deal in a very practical manner with the transfer of the received signal from the aerial to the first amplifying stage, and so on to the detection and frequency-changing portions of the receiver. The problems arising from the requirements of selectivity, gain and frequency control and the necessity of suppressing or limiting receiver noise, hum and spurious beats are described; and it is gratifying to find a whole and very practical chapter devoted to the important subject of screening in the various ways in which it is relevant to the design of a good radio receiver. Later chapters deal with power supply, routine measurements and fault finding.

The book is to be recommended as a good combination of theory and practice, and should be at the disposal of all engineers and physicists concerned with the design of radio-receiving equipment, whether of an experimental or commercial type.

Food and Farming in Post-War Europe

By P. Lamartine Yates and D. Warriner. (The World To-day Series.) Pp. 118. (London, New York and Toronto: Oxford University Press, 1943.) 3*s*. 6*d*. net.

THE reconstruction of European agriculture will be one of the most urgent and complex tasks confronting the United Nations on the conclusion of hostilities. It is not reconstruction so much as revolution that is required to dispel the grinding, hopeless poverty of the vast mass of peasantry that has been a chronic cause of economic and political unrest, particularly in south-eastern Europe. For the sake of brevity the authors of this book have simplified the presentation of the problem without, however, sacrificing clarity. There are far too many farmers in Europe, they produce the wrong kinds of foodstuffs, they are ill-fed, and they are unorganized economically. The basis of re-organization must be increased industrialization to relieve rural over-population, the substitution of intensive mixed farming for predominantly grain farming, and great improvements in technical efficiency and marketing. The rural and urban populations would be economically complementary, each providing a steady market for the produce of the other. The economic, social and political obstacles to the realization of such a plan are immense, and the authors confront them boldly. They are, however, confident that they can be overcome, and their arguments, supported by well-marshalled facts, lend support to their confidence.

Land, Air and Ocean

By R. P. Beckinsale. Pp. 407+18 plates. (London: Gerald Duckworth and Co., Ltd., 1943.) 15*s*. net.

TO compress into a single small volume an account of all aspects of the physical basis of geography is an ambitious task, but on the whole the author has been successful. It may be questioned whether the book is full enough for university work, but it certainly touches on nearly all problems that have to be considered and gives, on each chapter, useful and modern references for further study. There are even indications of the human bearing of the physical considerations. Naturally some parts are fuller than others. The chapters on the atmosphere are perhaps the best and include mention of much recent work. Some revision and amplification would not be out of place in the account of ocean waters and submarine relief, and in the paragraphs on icefields. On many subjects it is difficult to compile a short but comprehensive list of further reading, but a few additions would not be out of place in the chapters mentioned. There are several well-chosen diagrams and photographs. The book, though condensed, is most readable.

Tables of Legendre Associated Functions

By Zaki Mursi. (Fouad I University: Faculty of Science, Publication No. 4.) Pp. viii+286. (Cairo: Fouad I University, 1941.)

UNTIL recently the only tables of the associated Legendre functions $P_n^m(x)$ were those of Tallqwist (Helsingfors, 1906), who calculated them for values of n and m up to 8 and for values of x from 0·00 to 1·00. As the function vanishes when the positive integer n is less than the positive integer m, Tallqwist's tables contained 3,600 entries. He calculated functions of even order exactly, and those of odd order with an accuracy varying from four to ten decimal places. Now the Fouad I University at Cairo has provided a much more extensive table, for values of n and m up to 10, and for values of x from 0·000 to 1·000. The entries have been obtained correct to 8 decimal places, except for $n = 9$, 10 and m equal to or greater than 5, where, as the entries are large, the values have been calculated to four decimal places only. Parts of the tables have been checked by Dr. L. J. Comrie, whose knowledge and experience of mathematical tables are exceptionally wide.

The Biological Control of Insects

By Hugh Nicol. (Pelican Books, A.113.) Pp. 174+8 plates. (Harmondsworth and New York: Penguin Books, Ltd., 1943.) 9*d*. net.

THE control of insect pests by means of parasites and predators appeals to the biologist and the general public alike. The biologist sees in the method the practical application of scientific knowledge by the utilization of living organisms. To the public it forms an attractive chapter in the progress of applied science. Dr. Nicol has recounted the history and practice of the methods of biological control in an attractively written volume. His account is accurate, free from undue technicality and shows an unbiased detached viewpoint. It can be recommended to a wide circle of readers including scientific folk themselves. As the author remarks, there is science, and also material for philosophy, for the reader who looks a little beneath the surface of the story, here recounted, towards the deeper issues.

PRINCIPLES OF INSECTICIDAL BIO-ASSAY

By DR. H. HURST

Department of Colloid Science, Cambridge, and Imperial College of Science and Technology, London

THE need for standardized methods of testing insecticides has become an important factor in insecticidal research, especially where routine examination of new materials is desirable. Chemical assay may provide an index of the potential toxicity of an insecticide, but evidence has been provided recently to show that the influence of toxicant concentration in an insecticide may be completely obscured by variation in the physico-chemical properties of the carrier medium[1]. The fact that each component of an insecticide may contribute towards gross toxicity restricts the usefulness of chemical assay as an index of toxicity. Hitherto, attempts which have been made to correlate chemical and biological tests have been based on the invalid assumption that the main purpose of a carrier medium is to transmit the insecticide to the test insects, after which toxicant concentration is a limiting factor in biological activity. This assumption has provided a general basis for 'standard' methods of insecticidal bio-assay, in which attention has been directed more towards arbitrary elimination of unknown variable factors than towards the fundamental causes of this variation[2].

In the present article an attempt is made to analyse some of the main factors which influence dosage-biological activity relations in systems in which insecticides are brought into contact with insects under controlled conditions.

The fundamental variables in an insecticidal test system may be resolved into (1) the test insect, (2) the insecticide, and (3) the mode of application of the insecticide to the test insect.

The choice of test insect is of prime importance in the design of the particular test system, for when the insecticide and mode of application remain constant, insecticidal evaluation depends on the sensitivity and specific susceptibility of the test insect.

An insecticide generally consists of a toxic principle or toxicant which is dissolved or otherwise dispersed in a carrier medium, which may be a homogeneous liquid or a heterogeneous system of mixed components. The potency of the insecticide is then evaluated from dosage-biological activity relations, where 'dosage' refers to the application of a standard quantity of insecticide, and 'biological activity' is measured by some selected specific response shown by the test insect.

The biological activity of an insecticide may vary greatly according to the mode of application used. In practice, liquid insecticides are usually applied as an atomized spray, which may be used in the control of flying insects, or deposited as a 'film' on various surfaces for secondary transmission to insects which come into contact with these surfaces.

These considerations may be illustrated by some selected examples in which insecticides are applied to insects in systems which represent the limits of a range of conditions under which insecticides are generally used in practice.

System 1

Components.—Test insect; pure toxicant.

Mode of Application.—Complete immersion of test insect in pure toxicant.

The simplest method of external insecticide application consists in immersing the test insect in relatively large proportions of pure drug. Since the external drug phase is large in relation to the biological test system, the disturbing influences of drug depletion in the external phase and drug distribution between the carrier medium (which is normally present in insecticidal mixtures) are avoided. In practice, this type of system is rarely used, for it is important to measure insecticidal action over as wide a range of toxicant concentrations as possible. Moreover, very few insects will resist immersion in pure toxicant for a sufficient period of time to ensure accurate experimental observation of specific biological responses. Nevertheless, systems of this type are very useful for measuring the relative molecular reactivities of members of homologous series of drugs, since distribution between an external carrier phase and the biological system is not a limiting factor in drug access. Mature blowfly larvæ (*Calliphora erythrocephala*, *Phormia terræ-novæ*, *Sarcophaga falculata*) are suitable test insects which are extremely resistant to high toxicant concentrations present as an external insecticidal phase.

Even in simple systems of this type, complex factors are involved in the production of specific biological responses such as paralysis, or death. For example, a drug may 'induce' its own penetration or access through the cuticle by interacting with the lipo-protein components of the cuticle framework. In other words, the resistance of an insect to an insecticide depends on 'functional cuticle permeability', which is determined by the nature of the drug-cuticle association in the particular test system[1].

It has generally been assumed that drug specificity depends mainly on the molecular interaction of the drug with the ultimate cell receptors at the site of action in the biological system. But where the drug has first to penetrate through an intermediary biophase which links the site of drug application with the site of drug interaction, the effects of molecular specificity may be completely obscured by diffusion processes involved in drug access. In fact, with insects such as blowfly larvæ, the relative toxicities of drugs such as normal primary alcohols and fatty acids measured by iso-active external concentrations differ markedly from relative drug reactivities based on iso-active internal concentrations in the hæmolymph.

The importance of this fundamental conclusion lies in the implication that where differences in permeability exist between the cuticles of a range of test insects, the relative biological activities of a range of drugs or insecticidal mixtures measured with one particular species of test insect will not necessarily be similar to corresponding 'evaluations' with other species of test insects. This factor is a difficulty which stresses the need for caution in the correlation of the results of insecticidal bio-assay in different test systems, and shows that physiological factors must also be considered in assessing the toxicity of insecticides.

System 2

Components.—Test insect; toxicant; carrier.

Mode of Application.—Complete immersion in insecticidal mixture.

Systems of this type may be classified broadly into three main categories in which biological activity depends on certain limiting factors.

A. Carrier non-toxic; toxicant non-toxic. Carrier

+ *toxicant non-toxic*. Mature larvæ of the blowfly *Sarcophaga falculata* will remain active for more than an hour when immersed in kerosene or ethyl alcohol; mixtures of ethyl alcohol and kerosene are also relatively non-toxic. The limiting factor is the impermeability of the insect cuticle; variation in the relative proportions of carrier and toxicant produces no significant change in biological response.

B. Carrier non-toxic; toxicant non-toxic. Carrier + toxicant toxic. (1) When immersed in pure kerosene or ethyl alcohol, mature *Calliphora erythrocephala* larvæ behave similarly to Sarcophaga larvæ, and show no symptoms of paralysis even after an hour. Mixtures of ethyl alcohol and kerosene are extremely toxic, and the insects are rapidly immobilized—within a few seconds. The functional permeability of the cuticle is so high in the presence of kerosene that rapid access of the ethyl alcohol to the internal body fluids of the insect results in an increase in volume of about 50 per cent within three minutes. This stage is followed by the bursting of the insect when the internal pressures become excessive. These effects are produced with great rapidity by mixtures containing 20–80 per cent alcohol. On either side of this range equitoxic effects may be produced, showing that *toxicant concentration* is not necessarily a limiting factor in biological activity when an external insecticidal mixture is brought into contact with an insect. Where the concentration of alcohol is low, toxicity will increase with increase in alcohol concentration, since within this range toxicant concentration is a limiting factor in drug access. But where the concentration of ethyl alcohol is high, toxicity will decrease with increase in toxicant concentration, since within this range functional cuticle permeability decreases with decrease in carrier activity.

(2) A similar example of more practical importance is shown by the influence of 'carrier activity' on the biological activity of pyrethrins, which show a higher degree of insecticidal activity than any other known natural or synthetic insecticide. Primary symptoms of pyrethrin intoxication are produced very slowly when mature Sarcophaga larvæ are immersed in a concentrated pyrethrum extract containing 30 per cent pyrethrins*, and the insects become immobilized within 20–30 minutes. In this system the carrier for pyrethrins consists of a mixture of fatty acids, resins, and other impurities derived from the original pyrethrum extract, and carrier activity is low. Dilutions of this concentrated extract with a heavy oil of the medicinal paraffin type show no marked change in biological activity until low toxicant concentrations are reached, when further dilution with heavy oil produces a decrease in biological activity.

(3) If the original concentrate is diluted with a lower boiling paraffin fraction of the kerosene range, carrier activity becomes very apparent at very low concentrations of kerosene (2–5 per cent), and as dilution proceeds there is a progressive increase in biological activity of the drug mixture. This is due to the rapid increase in functional cuticle permeability which is induced by the association of the kerosene with the cuticle framework[1]. Carrier activity is inversely proportional to carrier viscosity, and in this system functional cuticle permeability is so high that complete paralysis is produced within 1–2 minutes by solutions containing pyrethrin concentration so low as 0·005 per cent. Evaluation of toxicant activity is only practicable within a very restricted range owing to the rapidity of paralysis inception.

Systems (2) and (3) represent the outer limits of a range of test systems in which toxicant activity may be used as an index of carrier activity, since the rate of drug access is determined mainly by the functional cuticle permeability.

C. Carrier toxic; toxicant toxic. Carrier + toxicant toxic. *Tenebrio molitor* larvæ are immobilized within 1–2 minutes by immersion in kerosene, ethyl alcohol, or mixtures of these components. Owing to the relative susceptibility of the test insects under the particular mode of application of the insecticide, toxicant and carrier activities are masked by carrier toxicity. In systems *A* and *B*, carrier toxicity is small. Many flying and crawling insects (for example, adult Diptera, larval and adult stages of Coleoptera, Lepidoptera, nymphal and adult stages of Orthoptera, Hemiptera) are susceptible to carriers such as kerosene, and such test insects are unsuitable for test systems in which the external insecticidal phase is relatively large in relation to the test insect.

From these examples it is clear that, in a particular test system, the biological activity of an insecticide depends not only on the nature and concentration of the toxicant, but also on all other components of the insecticidal mixture, irrespective of the toxicity of these components, and that bio-assay gives a measure of a gross summation of effects which may be analysed by the appropriate choice of biological component. In systems where carrier toxicity is not a limiting factor in bio-assay (*B*, (1), (2), (3)), relatively enormous changes in biological activity of an insecticidal mixture containing a fixed proportion of toxicant may be produced simply by variation of the carrier components. The importance of physiological factors is shown by the contributory influence of carrier toxicity on the biological activity of an insecticidal mixture. Where the external insecticide phase is relatively large, carrier toxicity may completely swamp bio-assay of toxicant activity (*C*). Where low cuticle permeability is a limiting factor in drug access, bio-assay of toxicant activity is also impracticable (*A*).

System 3

Components.—Test insect; toxicant; carrier.

Mode of Application.—Insecticide applied to test insect by secondary transmission from residual 'film' primarily deposited on absorbent substrate.

The difficulties inherent in methods of assay where the carrier itself is toxic may be surmounted by the introduction of an additional limiting factor into systems of the above type. For example, the poison mixture may be first deposited on a porous substrate where a proportion of the mixture becomes immobilized by absorption or adsorption processes. The deposit of poison mixture in the porous surface may be adjusted to form a thin film on the surface of the framework. 'Film activity' may be measured by introducing suitable test insects on to impregnated substrates which comprise a range of deposit volumes and toxicant concentrations. The biological responses produced depend on (1) toxicant concentration and (2) film thickness, which influences the transmission of insecticide to the test insects, and also 'sensitizes' the insects to the action of the toxicant. Where the insects are susceptible to carrier toxicity, excessive film thickness produced by substrate satura-

* The author is indebted to Dr. T. F. West (Messrs. Stafford Allen and Sons, Ltd., London) for preparing the pyrethrum extracts used in these experiments, and also for valuable technical advice.

tion deposits results in a system which approximates to system 2 *C*, and toxicant bio-assay is impracticable.

By the selection of an appropriate range of film thicknesses, the disturbing influence of individual biological variation on the susceptibility of the test insects may be largely eliminated by superimposing on this individual variation a predetermined wider range in 'functional susceptibility'. Where film thickness is small, insect functional susceptibility is low, and toxicant bio-assay is possible at high initial toxicant concentrations. Similarly, with increase in film thickness, there is a decrease in the threshold active toxicant concentration in the bulk phase of the insecticidal film. In this way bio-assay of insecticidal activity may be carried out over a relatively wide range in toxicant concentrations. The sensitivity of this method is illustrated in the accompanying table by some typical data for the insecticidal film activity of pyrethrum–kerosene sprays to *Calandra granaria* weevils.

Analysis of results. In practice the biological activity of an insecticide represents a summation of the effects of toxicant activity, carrier activity, and carrier toxicity. Hence a representative index of biological activity is obtained by summation or average of the biological responses produced by a given initial toxicant concentration applied at dosages *A*, *B*, *C*, *D*, which comprise a comprehensive range of carrier activities and carrier toxicities.

In the above system carrier toxicity becomes a limiting factor at substrate saturation deposits of approximately 0·3 c.c. per filter paper. The system approximates to system 2 *C*, and rapid immobilization of the test insects precludes bio-assay of toxicant activity. Dilution (0·05 per cent pyrethrins) may be conveniently used as a standard for comparison with a range of kerosene dilutions of pyrethrum-kerosene sprays of unknown pyrethrin content. Bio-assay is based on the ratio of average percentage paralysis per deposit range *A*–*D* to that of the standard. This ratio gives a coefficient, which may be expressed generally as the *I.C.T. Coefficient* (*I*, test insect; *C*, carrier; *T*, toxicant). In this way particular test systems may be specifically defined. For example, from the data summarized in the accompanying table the *I.C.T.* (*Calandra—kerosene—pyrethrins*) coefficients of film activity (3 hr.) of insecticides containing 0·06, 0·05 and 0·04 per cent pyrethrins, are 1·11, 1·00 and 0·86 respectively; corresponding values at twenty-four hours exposure are 1·10, 1·00 and 0·92 respectively. For this range, bio-assay of toxicant concentration is possible within wide limits of dosage exposures (3–24 hours); at higher toxicant concentration (0·06–0·10 per cent pyrethrins), bio-assay is obscured by excessive toxicant activity.

The insecticides are deposited uniformly on the filter papers by means of a graduated micro-pipette (total capacity 0·2 c.c.). With low-viscosity oils such as kerosene, diffusion equilibrium in the system insecticide–substrate is rapidly attained, and uniform sampling of the insecticidal film is brought about by the activity of the test insects. In practice, the number of standards used may be restricted to the range 0·04–0·06 per cent pyrethrins. The unknown insecticide is then diluted with standard kerosene spray base to give a range of insecticides which are approximately iso-active with those within the range of standards. The pyrethrin content of the unknown may then be assessed from the dilution factor. By the appropriate choice of standards and dosage deposits a wide range of pyrethrin contents may be assayed.

Bio-assay of pyrethrum heavy-oil preparations. The carrier activity of a heavy oil of the medicinal paraffin type (for example, Shell oil *P*.31) is small in relation to that of a carrier medium such as kerosene, and higher pyrethrin concentrations are necessary to produce comparable biological responses within a given period of exposure. A range of standards containing 2–0·2 per cent pyrethrins may be used for preliminary 'sorting out' tests. Sensitivity within this range is greatest in the region of 1 per cent pyrethrins. For example, the *I.C.T.* (*Calandra – P*.31 *– pyrethrins*) coefficients of solutions containing 1·2, 1·0 and 0·8 per cent pyrethrins are respectively 1·14, 1·00 and 0·59 (3 hr.); 1·09, 1·00, 0·76 (24 hr.).

Scope of Method. Measurement of *I.C.T.* coefficients at intervals gives an index of the nature of the intermediary chain of biological responses which culminates in eventual mortality. This is of importance where secondary toxicants or 'activators' may be present. In the system pyrethrins – kerosene – sesame oil, the kerosene is a *primary* activator for pyrethrins in so far as 'knock-down action' or paralysis is determined by the increase in functional susceptibility of the test insects which is induced by the kerosene. Sesame oil is a *secondary* activator which does not increase 'knock-down action' (high sesame oil contents of 30–50 per cent *decrease* the knock-down activity of pyrethrum-kerosene sprays by inducing a selective decrease in functional cuticle permeability), but results in combined action with pyrethrins at a later stage when the recovery phase of pyrethrin poisoning normally occurs. The efficiency of a secondary activator for pyrethrins, such as

Pyrethrum content of spray (% wt./vol.)	% Paralysis (3 hr.).					*I.C.T.* coefficient	% Paralysis (24 hr.)					*I.C.T.* coefficient
	A	*B*	*C*	*D*	Average		*A*	*B*	*C*	*D*	Average	
0·10	42	72	97	92	76	1·33	100	97	100	100	99	1·13
0·09	50	65	92	90	74	1·30	97	100	100	100	99	1·13
0·08	47	62	92	92	73	1·28	97	100	100	100	99	1·13
0·07	45	57	90	87	70	1·23	97	95	100	100	98	1·11
0·06	30	50	82	90	63	1·11	95	97	97	100	97	1·10
0·05	17	60	70	80	57	1·00	75	80	97	100	88	1·00
0·04	17	55	62	62	49	0·86	47	80	97	100	81	0·92
0·03	15	32	40	47	33	0·58	50	62	87	90	72	0·82
0·02	7	22	27	45	25	0·44	25	45	82	87	60	0·68
0·01	0	0	7	25	8	0·14	2	2	37	75	29	0·33

Substrate: Whatman No. 1 Filter paper, 7 cm. diameter.
Dosage Deposits: *A*, 0·1 c.c. (0·0026 c.c./sq. cm.)
B, 0·12 c.c. (0·0031 c.c./sq. cm.)
C, 0·14 c.c. (0·0036 c.c./sq. cm.)
D, 0·16 c.c. (0·0042 c.c./sq. cm.)

Initial age of films, 20 min.
40 Calandra weevils per filter paper (exposed in open petri dishes, 25° C.; relative humidity, 70 per cent).

sesame oil or *iso*butylundecylenamide, may be assessed from the minimum concentration of activator which eliminates the recovery phase of standard pyrethrum-kerosene solutions by the inception of secondary *irreversible* toxic action during this phase. Bio-assay of an insecticidal spray containing a secondary activator should be based on analysis of biological activity at various stages after spray application to the test insects. For example, under practical conditions, the 'knock-down' efficiency of a pyrethrin-oil spray for flying insects is influenced primarily by pyrethrin content and carrier activity of the oil medium; the secondary effect of activators such as sesame oil becomes apparent after this initial 'knock-down action'.

This method of assay, which involves the use of a range of dilutions of toxicant, has many features in common with the Rideal-Walker (R-W) test for the evaluation of the killing efficiency of disinfectants[3]. Here the weakest concentration of disinfectant killing standard bacterial cultures in a definite time period is divided by the weakest concentration of phenol killing in the same period; the ratio is the phenol coefficient. With a range of dilutions to cover threshold toxic concentrations, greater sensitivity is obtained than is possible using a reference standard at a single fixed concentration.

System 4

Components. Test insect (flying); toxicant; carrier in closed chamber.

Mode of Application. Insecticide introduced into chamber as atomized spray.

In Systems 1 and 2, where the external insecticidal phase is large in relation to the biological component, the capacity of the insecticide/cuticle interface for transmission of insecticide to the insect is at a maximum, and toxicant dosage is mainly determined by functional cuticle permeability and by the period of immersion in the insecticidal mixture, since carrier toxicity is not a limiting factor in bio-assay. In System 3, carrier toxicity may be eliminated as a dominant factor in biological activity by a controlled mode of application of insecticide in which the bulk of the insecticide is primarily immobilized in a porous substrate so that secondary transmission to the insect is determined by the *local* capacity for transmission of insecticide at the insecticidal film/cuticle interface. In Systems 1, 2 and 3 the relations of the insecticidal components and test insects are such that uniformity in the mode of application of insecticide to the test insects may be controlled so as to assess the relative influence on gross biological activity of toxicant activity, primary carrier activity, carrier toxicity, and secondary adjuvant or activator activity.

Where the test insects are flying insects enclosed in a spray chamber, and the insecticide is introduced as an atomized spray, individual insect dosage is largely dependent on the insect distribution and spray distribution relations. A system of this type is used in the Peet-Grady method, which is the official method of the National Association of Insecticide and Disinfectant Manufacturers for evaluating liquid insecticides[4]. Uniformity of experimental conditions is obtained by arbitrary standardization of unknown variables. The test procedure involves the use of a standard fly-rearing room, testing room, test chamber, fly cages, atomizer, and insecticide paper which is used to line the floor of the test chamber in which the flies are sprayed.

The dosage-biological activity relations in this method of test are extremely complex. For example, reduction of exposure time of 10–5 min. has been shown to have little influence on the knock-down and kill when a standard 12 ml. dosage is used[5]. An extension of these experiments by the present author has shown that an increase in exposure period from 5 to 120 minutes results in only a slight increase in toxicity. The kills obtained at exposure periods of 5, 10, 15, 20, 30, 60 and 120 minutes were 35, 36, 32, 34, 36, 43 and 49 per cent respectively*. It is interesting to note that despite a large variation in exposure period the relative biological activities of standard dosages sprayed into the chamber remain relatively constant. This indicates that toxicity is mainly determined by the initial dosage transmitted to the flying insects during and shortly after spraying, although with kerosene-type sprays a residual 'mist' of finely atomized spray droplets may persist for about twenty minutes. The reproducibility of the results obtained under these conditions cannot be attributed to uniformity in individual fly dosage. A threefold variation in average fly dosage has been demonstrated by a careful colorimetric analysis of the individual dosages received by flies sprayed with insecticides containing suitable dyes under standard Peet-Grady test conditions[6]. This evidence suggests that fly distribution is a dominant factor in individual fly dosage – biological activity relations, since the gross variation in individual fly dosage can scarcely be ascribed to lack of replication in the gross characteristics of spray distribution. The disturbing influence of spray distribution is shown by the fact that the relative toxicity of pyrethrum-oil insecticides may be completely reversed by variation in the sprayer used. Moreover, the present author has found that at spraying pressures of 2, 12·5 (normal), and 25 lb./sq. in., the kills produced by standard 12 c.c. dosage of *O.T.I.* (Official Test Insecticide, approximately equivalent to 0·1 per cent *W/V* pyrethrins in a kerosene spray base) were 15, 36 and 45 per cent respectively, showing that toxicity increases with spraying pressure*.

From this evidence the general conclusion may be drawn that in systems in which an insecticide is applied as a spray to flying insects confined within a closed chamber, uniformity of individual insect dosage is limited by dominant factors of fly distribution and spray distribution, which are characteristic of particular systems.

This fundamental conclusion has provided a basis for the investigation of the general dosage – biological activity relations in systems of this type. A detailed account of the numerous variable factors involved is beyond the scope of the present article, and will be given elsewhere, but the following brief summary will serve to illustrate the complexity of the factors which contribute towards gross toxicity.

(1) For a given test chamber and sprayer, bio-assay of toxicant activity may be completely obscured by variation in carrier activity. A standard dosage of a solution of 0·1 per cent pyrethrins in a heavy oil carrier (Shell oil *P*.31) produces only a slight knock-down action (30–50 per cent) during the standard exposure of ten minutes in a Peet-Grady chamber, and cannot be evaluated by comparison with a similar standard consisting of a 0·1 per cent solution of pyrethrins in kerosene where carrier activity is high[1].

(2) Where the toxicant has a relatively high vapour pressure (for example, organic thiocyanites

* The author is indebted to the Shell Refining and Marketing Company, Technical Prods. Dept., London, for the use of a Standard Peet-Grady Chamber in which these tests were carried out.

such as 'lethane' or 'thanite'), toxicity depends on (1) contact activity of the toxicant carrier liquid phase, and (2) fumigant activity of the toxicant phase; (2) is relatively independent of (1).

Some rather 'aberrant' results may be obtained when spray chambers are used for the evaluation of insecticides in which different toxicants and carriers are present. For example, the toxicity of an insecticide consisting of a solution of pyrethrins in heavy oil *increases* on dilution with a kerosene spray base owing to an increase in carrier activity (*cf.* systems 2*B*, 2, 3). On the other hand, variation in carrier activity produces only a slight variation in toxicity of sprays containing lethane or thanite, since fumigant toxicant activity is an important factor in gross toxicity. In other words, for given initial toxicant concentrations the relative toxicities of pyrethrum–oil, lethane–oil, and thanite–oil sprays may vary within wide limits simply by appropriate 'adjustment' of carrier activity. Two per cent thanite–oil sprays which show a higher official Peet-Grady rating than *O.T.I.* show a considerably lower rating when tested by the *I.C.T.* coefficient rating (System 3), since fumigant activity is no longer a limiting factor in bio-assay.

(3) With decrease in chamber size, the disturbing influences of fly distribution and spray distribution factors on individual fly dosage diminishes, since it is possible to attain more uniform and higher initial spray concentrations than is practicable with larger chambers of the Peet-Grady type. This is shown by the relatively high initial rates of knock-down produced in the smaller chambers, especially where the toxicants used exert fumigant activity. Similar results have been obtained independently by other investigators[7].

(4) Where the spray storage capacity of the floor of the spray chamber is small, secondary transmission of insecticide from the floor of the chamber to the test insects may be an important factor in gross dosage-mortality relations, since the bulk of the spray is eventually deposited on the floor (*cf.* System 3). The adhesion of finely atomized oil spray droplets to vertical surfaces in the chamber is relatively small. Where the floor of the chamber is lined with an absorbent surface or substrate of high spray storage capacity, film activity is slight and toxicity is mainly influenced by initial spray administration and residual 'mist action'.

It is clear that the physico-chemical factors which influence the dosage–biological activity relations in fly spray chamber methods of insecticidal bio-assay are extremely complex and only become apparent after comparison with much simpler systems of the types 1, 2 and 3. Careful arbitrary standardization of unknown variable factors in the Peet-Grady method is of doubtful significance where variation in carrier activity may obscure variation in toxicant activity. In fact, the use of a standard reference insecticide such as *O.T.I.* as a basis for the evaluation of pyrethrin content in samples of unknown composition is only valid for a restricted range of insecticides in which carrier activity is of a similar order to that in the standard. Where the unknown samples contain toxicants other than pyrethrins, bio-assay provides an index of a gross summation of effects which are characteristic of the particular test chamber and do not necessarily hold in other chambers or under practical conditions of test where, for example, fumigant activity is negligible. Caution is also necessary in the correlation of the biological activity of a spray with some relatively simple factor such as particle size distribution, for kinetic factors are also involved in the transmission of the spray droplets to the insects. High viscosity oils, even when finely atomized, are ineffective under practical conditions owing to dispersion factors, and droplets of less than 17 microns seldom strike the object towards which they are sprayed[8].

It is hoped that the principles which have been illustrated in the present article may serve as a guide to other investigators in the field of insecticidal research, especially those who are primarily concerned with the bio-assay of insecticidal preparations of unknown composition and physico-chemical properties. It is only from the scientific analysis of the limiting factors which influence the biological activity of an insecticide in a selected range of controlled test conditions that the ultimate efficiency of the insecticide under more variable field conditions may be assessed with any degree of accuracy.

[1] Hurst, H., NATURE, **145**, 462 (1940); **147**, 388 (1941); **152**, 292 (1943).

[2] Gnadinger, C. B., "Pyrethrum Flowers", 2nd ed. (Minneapolis, 1936). Shepard, H. H., "The Chemistry and Toxicology of Insecticides" (Minneapolis, 1940). Campbell, F. L., *Soap and San. Chem.*, **18**, 119 (1942).

[3] Rideal, S., and Walker, J. T. A., "Approved Technique of the Rideal-Walker Test", pp. 12 (London, 1921). Ruele, G. L. A., and Brewer, C. M., *Soap and San. Chem.* Blue Book, 117 (1942).

[4] Anon., *Soap and San. Chem.* Blue Book, 184 (1942).

[5] Ford, J. H., *Soap and San. Chem.*, **17**, 91 (1941).

[6] Murray, C. A., *Soap and San. Chem.*, **16**, 111 (1940).

[7] Kearns, C. W., and March, R. B., *Soap and San. Chem.*, **19**, 101 (1943).

[8] Searls, E. M., and Snyder, F. M., *J. Econ. Ent.*, **29**, 1167 (1936). Searls, E. M., *Soap and San. Chem.*, **18**, 97 (1942).

THE BIOLOGICAL SECTION OF THE UKRAINIAN ACADEMY OF SCIENCES

By NIKOLAI GRISHKO

AT the present time the Ukrainian biologists are working in the sister republic of Bashkiria, where the Ukrainian Academy of Sciences was evacuated from its home in Kiev.

The Institutes of the Academy are continuing their valuable research work on the development of theoretical subjects in various branches of biology, and at the same time have included in their programmes of work a number of practical problems connected with war surgery, therapy and general war medicine, and problems connected with the maximum utilization of the natural resources of the country and the increase in the output of agricultural products.

Several of the Institutes' laboratories are working on problems connected with the more rapid healing of wounds, the knitting of fractured bones, problems connected with relieving the sufferings of the wounded and ensuring their more rapid return to the ranks.

Prof. A. Bogomolets, director of the Institute of Clinical Physiology, has proved that the employment of the anti-reticular cytotoxic serum is very effective in speeding up the processes of healing flesh and knitting broken bones.

This new treatment is already widely used in the hospitals and clinics of the Soviet Union. It is one of the results of many years research by Prof. Bogomolets and his pupils into the part played by

connecting tissues in the organism, research work which is being successfully continued to-day.

Prof. Nina Medvedova, one of Prof. Bogomolets' colleagues, has discovered new functions of the cortex of the suprarenal glands—functions which regulate carbohydrate metabolism. She has succeeded in producing, in the form of an extract, the hormone of the cortex of these glands, which she has named 'corticalin'. Corticalin is a hormone regulating the recreative phase of carbohydrate metabolism and is therefore known as the 'rest hormone'.

Profs. Fyodor Primak and Vassily Vasilenko, of the same Institute, working under the direction of Prof. Nikolai Strazhesko, are studying a number of clinical problems in war medicine, in particular the working out of methods of oxytherapy. They are successfully continuing their study of the process of re-establishing the role of the haemato-parenchymatose barrier in the human organism.

The Institute of Biochemistry has achieved very important results since the War began. The researches of Prof. Alexander Palladin, director of the Institute, into problems of the biochemistry of vitamins and the biochemistry of foodstuffs in general are of very great importance.

The Institute of Biochemistry is also carrying out research into the biochemistry of the nervous system and the biochemistry of muscular action in connexion with problems raised by clinical medicine, including the problem of the struggle against fatigue.

The Institute of Botany has been working since war began on the cataloguing and utilization of wild plants for defence purposes, and on increasing the output of agricultural products, both foodstuffs and industrial raw materials, to cover the needs of the army at the front and the people behind the lines.

The wild plant life of the Republic of Bashkiria, which is very rich in medicinal herbs, is being studied under the direction of Dr. Mikhail Kotov. A number of leaflets and pamphlets on the "Medicinal Herbs of Bashkiria" have been published. A number of wild-growing food and industrial plants are being utilized as the result of an Academy expedition.

The Agrochemical Section of the Institute of Botany has rendered great war-time service. Prof. Pyotr Vlasiuk has worked out methods of fertilization and farming processes for the cultivation of sugar beet and kok-saghyz, both of which are new crops in the eastern districts of the Soviet Union.

Prof. Nikolai Grishko, director of the Institute of Botany, is continuing his research into the sex genetics of hemp, employing the bi-sexual forms which he has produced in which male plants turn into female at the end of the vegetation period. The improvement of a sort of hemp which he produced earlier is being worked on. This sort is bi-sexual, both sexes reaching maturity simultaneously, making it possible to reap the crop entirely by mechanized methods.

Prof. Andrei Sapegin, who produced new sorts of winter wheat and barley which before the War were sown on 3,750,000 acres, is studying genetic processes of the reproductive organs of cultivated plants.

The laboratories of the Institute of Botany are working on new methods of the selection of hybrid pollen-bearing plants, in particular maize, and studying a number of problems in the cyto-embryology of plants. All this work aims at an increase in the output of agricultural products and an increase in war harvests.

OBITUARIES

Lady Lockyer

AFTER a long and active life devoted to wide social and scientific interests, Lady Lockyer, widow of Sir Norman Lockyer, died at Sidmouth on September 9, following a few days illness. She was ninety-one years of age, and her earthly body now rests in the little churchyard of Salcombe Regis close to that of her husband, who was buried there twenty-three years ago. The Norman Lockyer Observatory on the summit of Salcombe Hill is an outward and visible sign of the exaltation of their spirit to the skies.

Lady Lockyer was the younger daughter of Mr. S. W. Browne, and she with her sister, the late Miss Leigh Browne, became associated with Sidmouth from their childhood days through prolonged visits to their grandparents, Captain and Mrs. Carslake. When living in London they were students at Queen's College, which was founded in 1848 by F. D. Maurice, Henry Morley and other men of "light and leading" to provide scholarly training for girls. The two sisters took an active part in social work in Whitechapel associated with Canon and Mrs. Barnett at Toynbee Hall, and in other public affairs and women's movements. They were the prime movers in the establishment of the first hall of residence for women students in London. An appeal was made for funds to provide such accommodation for women students at University College and the London School of Medicine for Women, and in 1882 the Misses Browne took the lease of a house in Bloomsbury for a term of twenty-one years and placed it at the disposal of a committee appointed to carry out the project.

The first student to come into residence was Miss Cicely Ullman (later Mrs. Sidgwick), and the house was soon full. It became clear that a real need had been met and that further accommodation was required. Two adjoining houses were afterwards leased, but when the lease terminated it was decided to build a College Hall in Malet Street on a freehold site and large enough to accommodate 112 students. The foundation stone of this Hall was laid in October 1931, when Lady Lockyer gave an address on its origin and growth. The new Hall was opened by Queen Mary in 1932 and became the chief residential centre for nearly two hundred women university students in London, until it suffered very severe damage from enemy action during the present War.

Lady Lockyer was the widow of Mr. B. E. Brodhurst, F.R.C.S., when she and Sir Norman were married in 1903. In the same year Sir Norman was president of the British Association, and her gracious presence will be remembered by many members who attended the Southport meeting. Later, they left their London house and occupied one built for them facing the sea on the picturesque slopes of Salcombe Regis. After taking up residence in this house, Sir Norman decided that the summit of Salcombe Hill was admirably suited for an astronomical observatory, as it possesses an unbroken horizon in every direction. With characteristic energy he set about constructing an observatory on this site in 1912. About seven acres of land were presented for the site by Sir Norman and Lady Lockyer, and a number of their friends made generous gifts to build and equip this Hill Observatory, as it was first named. In 1916 the Observatory was formed into a corporation to promote its development, and all the lands, buildings and equipment

were conveyed to that body. The name was changed to that of the Norman Lockyer Observatory and the management and control were vested in a council of astronomers and other men of science.

In addition to the land on which the Observatory is situated, Sir Norman and Lady Lockyer contributed during their lifetimes sums amounting to about £11,000 to the Observatory, as well as valuable instruments. Sir Robert Mond, who was chairman of the Corporation until his death in 1938, had a new photographic equatorial constructed and a building erected to house it, his gifts amounting to about £7,500. Sir Francis McClean presented the fine twin-telescope used by his father, Dr. Frank McClean, and other gifts amounting to about £10,000, and his brother, Captain W. N. McClean, has contributed about £5,000 to the funds of the Observatory in addition to designing the domes of the chief instruments and supervising their construction. No other observatory in Great Britain has been built, equipped and maintained on this rich scale of donations from private benefactors.

By Lady Lockyer's death, the Observatory is provided with additional means for its development, in which she always took the keenest interest, and of which she was the honorary treasurer until her death. She has bequeathed to the Observatory Corporation the freehold house at Salcombe Regis in which she and Sir Norman lived, and most of its contents, as well as about forty acres of land up to the summit of the hill on which the Observatory stands, and a farm of eighteen acres and a cottage. It is rarely that such substantial benefactions are made in Great Britain for the advancement of astronomy, though they are common in the United States. They ensure permanent provision for purely scientific research at a time when attention is chiefly concentrated on investigations of possible industrial or other practical value. All who are interested in the pursuit of knowledge and the intellectual expansion produced by it will pay grateful tribute to the spirit and service by which Lady Lockyer used her faculties and means with wisdom and social understanding, not only during her life, but also provided for the continuance of this influence after she had passed into silence.

Lady Lockyer was elected a fellow of the Royal Astronomical Society in 1923, a few years after the Society had decided to admit women into its fellowship. Her cheerful and stimulating presence will be greatly missed by all who came into contact with her and she will long remain in esteemed and cherished memory.

R. A. GREGORY.

Mrs. Thoday

MRS. MARY GLADYS THODAY (*née* Sykes), whose death at the age of fifty-nine occurred on August 9, will long be remembered as a keen and versatile botanist. A distinguished student of Girton College, Cambridge, she obtained first-class honours in both the first and the second part of the Natural Sciences Tripos, after which she commenced research work in botany first as Bathurst student and later as fellow of Newnham College.

Attracted to cytological work, she published some interesting contributions on the structure and the division of the nucleus in Funkia and also some important accounts of the histology of several of the Laminariaceæ and the histological relations between Cuscuta and its hosts. But her active mind was many-sided in its interests, and even while engaged in the researches just mentioned she turned her attention to the anatomy and morphology of some of the peculiar vascular cryptogams like Psilotum and Tmesipteris, also of the Gnetaceæ; publishing accounts of first-rate importance of both groups in the *Annals of Botany* and the *Philosophical Transactions of the Royal Society*. She also collaborated with one of her contemporaries at Cambridge, David Thoday (now professor of botany at University College, Bangor) in work on the physiology of plants and in genetics. Those who remember the eagerness of her mind at this time are not surprised at the remarkable output of her scientific work.

In 1910 she married David Thoday, but family cares did not interrupt her botanical work, and when her husband was appointed lecturer in plant physiology in the University of Manchester she was elected honorary research fellow in the University, and in addition to her private investigations she took some share in the botanical teaching. On their removal to Cape Town, where Thoday was appointed to the professorship of botany in 1919, Mrs. Thoday joined her husband in the study of the flora of South Africa on extensive botanical excursions and also continued her investigation of the Gnetales, and at the request of Prof. Seward revised and completed the authoritative book on this group of plants which the late Prof. H. W. Pearson had left unfinished and on which she expended much time and labour. After the return of the Thodays to Great Britain, Mrs. Thoday's interest in botany continued, and she was appointed honorary lecturer in botany in the University College of North Wales.

During a visit to Canada with the British Association in 1924 she collected material of the minute mistletoe *Arceuthobium pusillum*, and an investigation on this plant was begun on the lines of her earlier work on Cuscuta, but it was left unfinished owing to her serious illness.

During the War of 1914–18, Mrs. Thoday threw herself actively into the constitutional movement for women's suffrage, and while in South Africa she became interested in native welfare and the complex racial problems which beset that country.

After a serious illness in 1925 public affairs again claimed her interests and she gave an increasing amount of her time and energy to the promotion of international understanding and goodwill. The deterioration of the European situation towards the end of 1938 played no small part in her tragic breakdown in health in 1939, from which she never fully recovered. Those who know the prodigious amount of secretarial and organizing work, as well as public speaking, which she accomplished during the years 1925–38, can well imagine how much she might have continued to contribute to botanical knowledge in a peaceful world. Her four sons are all serving overseas.

F. E. WEISS.

Dr. H. G. Baynes

DR. H. GODWIN BAYNES, who died on September 6, was the leader of the Jung school of analytical psychology in England. His chief interest was not always, however, directed towards the intangible gossamer of the soul. He was a man well over six feet high, with breadth not belying his height, and with physical powers that gave him his 'blue' and led him in his university days to row for Cambridge against both Harvard and Oxford.

Educated at Trinity College, Cambridge, he became house physician at 'Barts' during 1909–10. He acted as surgeon in the Red Crescent Mission to Turkey in the Balkan War of 1911–12, and after an interval of general practice at Wisbech became captain in the R.A.M.C., and in this capacity served in France, Mesopotamia and Persia. After the War of 1914–18 he took up a post on the resident staff at the Maudesley Hospital, and it was in connexion with his psychiatric work that he became, during 1919–22, assistant to Prof. (then Dr.) C. G. Jung in Zurich.

This was the turning point in Baynes's career. Henceforth his energies were devoted, both through the practice of psychotherapy and through the printed word as well as by means of numerous addresses to public and private bodies, to the dissemination of Jung's psychological doctrines. He not only translated Jung's major scientific work "Psychological Types" and edited and translated his "Contributions to Analytical Psychology" and "Two Essays on Analytical Psychology", but also wrote, in addition to numerous papers on psychiatry, medicine and folk-lore, a 900-page work entitled "Mythology of the Soul", and a last work on "Germany Possessed".

Baynes also organized and took part in the expedition which Jung made to East Africa during 1925–26 for the purposes of psychological research among the Massai tribes of Mount Elgon in Kenya.

Psychologists are apt to be thought of as formidable, if at times misguided, intellectuals. Baynes was far removed from such a category. Large-hearted as well as large-limbed, he added to his technical knowledge a warmth and sympathy that gave heart and assurance to those whom he helped to find their way, through the labyrinthine passages of the soul, towards that state of integration which results from a full recognition of the healing factors that lie buried in the collective unconscious in which he was such a firm believer. His loss is keenly felt by numerous patients and yet more numerous friends, and not least by the members of the Analytical Psychology Club in London, which he founded and led until his untimely death in full vigour at the comparatively young age of sixty-two.

JOHN LAYARD.

Dr. L. F. Barker

DR. LEWELLYS FRANKLIN BARKER, the eminent American anatomist and physician, who died after a long illness at Baltimore on July 13, was born at Norwich, Ontario, on September 16, 1867. He received his medical education at Toronto, Leipzig, Munich and Berlin, and qualified in 1890 at Toronto, where he worked at the general hospital for a year, and from 1894 until 1900 was attached to the Johns Hopkins University as associate professor of anatomy and pathology. From 1900 until 1905 he was professor of anatomy at Rush Medical College, Chicago, and for the next eight years was professor of medicine and chief physician at Johns Hopkins Hospital; he was appointed emeritus professor in 1921.

Prof. Barker was a prolific writer both on anatomical and medical subjects. His anatomical work included a translation of Spalteholz's "Hand Atlas of Human Anatomy" (1933), "Laboratory Manual of Human Anatomy" conjointly with Dean DeWitt Lewis and D. G. Revell (1904), and "Anatomical Terminology with special reference to the B.N.A." (1907); his chief medical works were "Tuesday Clinics at Johns Hopkins Hospital" (1922) and "Clinical Diagnosis of Internal Diseases" (1923), "Degenerative Diseases" with T. P. Sprunt (1925) and "Rheumatism; its Meaning and its Menace" (1926). He was also editor of "Endocrinology and Metabolism", by ninety-eight contributors (1922–24), in which he wrote part of the section on the parathyroid glands. His last works were "Psychotherapy" (1940) and his autobiography entitled "Time and the Physician" (1942).

In 1931–32 in honour of his sixty-fourth birthday, *International Clinics* published a Lewellys Barker *Festschrift* to which more than forty medical men contributed, including the well-known historian Fielding H. Garrison, who summarized his character as follows: "An austere devotion to duty and the things of the mind is set off by a distinction of appearance, a charm of personality, an hospitable nature, an open-minded freedom from prejudice, an innate kindliness of disposition, which are by no means least among the attributes of the beloved physician".

He received many honours, being hon. M.D. of the University of Toronto and LL.D. of Queen's University, Kingston, Ontario, and McGill University, Montreal. He was vice-president of the American Medical Association (1916–17), president of the Association of American Physicians and the American Neurological Association. He also enjoyed a European reputation, being foreign member of the Budapest Royal Society of Physicians, the German Society for Internal Medicine and Children's Diseases, the Medico-Chirurgical Society of Edinburgh and the Swedish Medical Society.

J. D. ROLLESTON.

Dr. H. C. H. Townend

DR. HERBERT CHARLES HENRY TOWNEND, who was accidentally killed on August 19, was born in London on March 18, 1896, and was educated privately. In 1915, he enlisted as a private in the Honourable Artillery Company and after receiving a commission in the London Regiment was attached to the Royal Air Force as an observer and served in Salonika, Egypt and Palestine. On returning to civil life, in 1919, he became a student at the Northampton Polytechnic, University of London, and obtained the B.Sc.(Eng.) (Lond.) degree, with first-class honours, in 1923. In October of that year he joined the staff of the National Physical Laboratory as a scientific officer. He took part in experimental work in the Aerodynamics Department covering a number of different subjects, but was best known to the outside world as the inventor of the Townend ring, a cowling device used to reduce the drag of the exposed cylinders of air-cooled engines. He made this discovery by accident when engaged on work with quite a different object, a chance observation directing his thoughts in a direction which ultimately led to the development of the ring. Townend was granted a patent on the device and it was at one time very widely used. For his work in this sphere he was awarded the Silver Medal of the Royal Aeronautical Society in 1931 and was awarded a D.Sc.(Eng.) (Lond.) in 1932. Dr. Townend was elected an associate fellow of the Royal Aeronautical Society in 1930 and a fellow in 1933. He was also an honorary scientific member of the Institute of the Aeronautical Sciences of the United States.

Townend's greatest contribution to the service of aerodynamics, however, was his fundamental study

of the properties of turbulent flow. He devised an exquisite technique in which tiny spots of hot air were produced by minute electric sparks at various points in the field of flow to be examined, and the subsequent motion of these 'hot spots', as he called them, was observed by cinema-photography. By these means he was enabled to follow the details of the turbulent motion, and the results of his investigations have been of great value in the subsequent development of the subject. He was a brilliant experimenter, one of those rare men who can improvise apparatus out of almost nothing, fit it up with their own hands, and produce important results by its use. This characteristic showed itself also in his private life, for one of his favourite hobbies was the invention and construction of very clever, but very simple, mechanical toys, some of which reached the Patent Office and the general public.

In 1937, Townend left the National Physical Laboratory and joined the staff of the Admiralty as an adviser on aerodynamic problems. The nature of his work was now completely changed, and instead of making experiments himself on a particular subject, he found himself supervising the experimental work of others and taking a broad view of the whole field of aerodynamics as it affected the problems of the Fleet Air Arm. That he was as successful in this as he had been as an original investigator is ample testimony to his great gifts and his clear vision. He maintained a very close contact with the National Physical Laboratory and was a frequent visitor to his many friends and former collaborators there. He had a delightful personality, and was a very interesting conversationalist. His many friends will feel a deep personal loss, and the science of aerodynamics has undoubtedly lost one of its most brilliant exponents.

WE regret to announce the following deaths:

Dr. J. J. C. Bradfield, C.M.G., Australian representative on the Council of the Institution of Civil Engineers during 1936–39, formerly chief engineer of the Sydney Harbour Bridge, aged seventy-five.

Prof. A. E. Bunge, professor of statistics in the University of Buenos Aires and director-general of national statistics, aged sixty-three.

Mr. Paul R. Crimp, student probationer at the Laboratory, Plymouth, and whaling officer, Ministry of Agriculture and Fisheries, in North Africa, aged thirty-one.

Prof. H. Lundborg, professor of racial biology in the University of Uppsala.

Prof. J. M. MacFarlane, emeritus professor of botany in the University of Pennsylvania, aged eighty-seven.

Dr. E. J. H. Mackay, the well-known archæologist, on October 2, aged sixty-three.

Prof. Peter Mühlens, director of the Bernard Nocht Institute for Naval and Tropical Diseases, Hamburg, aged sixty-seven.

Prof. A. A. Read, emeritus professor of metallurgy in the University College of South Wales and Monmouthshire, Cardiff, on September 24, aged seventy-five.

NEWS and VIEWS

Fisheries of Mauritius: Appointment of Dr. J. F. G. Wheeler

DR. J. F. G. WHEELER, lately director of the Bermuda Biological Station for Research Incorporated, has been appointed marine biologist in Mauritius. Dr. Wheeler was assistant lecturer in zoology at the University of Bristol and during 1924–31 was naturalist on board the R.R.S. *Discovery* engaged on whaling investigations in the Antarctic, before taking up his duties at Bermuda. The object of the Mauritius appointment is to obtain for Mauritius the services of an expert to examine the marine and freshwater fisheries with a view to the possible establishment of a permanent fisheries control organization to improve existing nutrition standards of the islanders. It is hoped that Dr. Wheeler's researches may be a prelude to the establishment of a Fisheries Department for Mauritius as a permanent institution. The present scheme for the development of the island's fisheries has been made possible by a free grant up to £4,500 under the Colonial Development and Welfare Act, 1940.

Copernicus

THE Selby Lecture, delivered on May 27 by Sir Harold Spencer Jones, the Astronomer Royal, at Cardiff was on Copernicus (Cardiff: Univ. of Wales Press Board. 1*s.* 6*d.* net). The lecture covers much the same ground as the article by the Astronomer Royal contributed to NATURE of May 22, but a few additional points are worth noticing. For a long time after the publication of "De Revolutionibus", it was believed that Copernicus was the author of the prefatory note which stated that it was not necessary that the hypotheses advocated should be true or even probable; it was sufficient that they should lead to results in agreement with observation. Although Osiander wrote the prefatory note without Copernicus's knowledge, this was not known at the time, and there was a widespread belief in the sixteenth century that Copernicus had advanced his theory merely as a mathematical device which he did not consider corresponded to any physical reality. Another very interesting matter should be mentioned. Although Copernicus accepted the value for the solar parallax found by Hipparchus, namely, 3′, which implied that an astronomical unit was about one twentieth of its true value, yet the relative mean distances of the planets from the sun, obtained by Copernicus, were remarkably accurate when compared with the most recent determinations. Objections to the Copernican system arose *inter alia* on the question of the distance of the stars, and opponents contended that Copernicus had assumed a great distance for the stars merely to obviate the serious difficulty that they showed no parallax. This was the main reason for the rejection of the Copernican system by Tycho Brahe, and his substitution of a geocentric system in which the sun and moon revolved round the earth, but all the other planets revolved round the sun. Copernicus would not commit himself to any definite statement regarding the infinite distance or otherwise of the stars, and Bruno is usually regarded as the pioneer of the conception of an infinite universe and an infinite number of

worlds, though he was anticipated in this by Thomas Digges.

THE recent issue of *Polish Science and Learning* (London: Oxford University Press) is devoted to articles dealing with the life and work of Copernicus, prepared in connexion with the quatercentenary celebrations held earlier this year. One of these is by Sir Harold Spencer Jones, the Astronomer Royal (see NATURE, May 22, p. 573); another, by Prof. H. Dingle, was referred to in the same issue (p. 576). In addition, Prof. St. Kot has contributed an address entitled "The Cultural Background of Copernicus", which shows how greatly indebted Copernicus was to the University of Cracow for his cultural polish. From letters written at the time, we learn that his university life was spent in an atmosphere which favoured independence of thought, enthusiasm for research, and provided the opportunities for developing universal, unfettered personalities. Mathematics and astronomy were predominant in the University, and humanist poetry also took a prominent place. Cracow was the only university north of the Alps in the fifteenth century which had two chairs of astronomy, and several of Copernicus's fellow-students devoted themselves to the study of astronomy and geography. Although he carried out prolonged studies after leaving Cracow in Bologna, Rome, Ferrara, and Padua, the University of Cracow was the first to take an approving interest in his discovery, and the professors there were the first to use Copernicus's astronomical calculations.

H. Kucharzyk has an article entitled "The First Disciples of Copernicus in England (Early English Copperniciana)", which deals with the evolution of astronomy in England in the second half of the sixteenth century. The first English scientific man who was a real adherent and ardent supporter of the Copernican idea was Thomas Digges (1546–59), who was known as an astronomer and also as one of the leading mathematicians of Elizabethan times. His work, "A Perfit Description . . .", which appeared in 1576, is regarded as the principal English treatise on the Copernican system printed before the second quarter of the seventeenth century. H. Kucharzyk has also a short article with the title "Copernicus as Economist, Statesman, and Poet", and shows Copernicus's knowledge of monetary questions. In his treatise "De Monetæ Cudendæ Ratio", published in 1526, he formulated the principle which was later known as Gresham's Law, that bad money in circulation with good will drive out the good. His work in political spheres, as a physician, administrator, commander-in-chief of the beleaguered city of Olsztyn, and also as a poet, is dealt with very briefly in this article.

Mass Asphyxia

IN the tube shelter disaster in March of this year 173 people (28 men, 83 women and 62 children) lost their lives as the result, not of enemy action, but of a woman's fall with a child as the crowd was entering the shelter in a reasonably orderly manner. Others fell on top of the woman and the child, and within a few seconds there was a pile of people 3–4 ft. high. Some three hours later all casualties had been cleared. Some people at the top of the pile were dead, some at the bottom were living. Almost the last person extricated was a girl of about seven, who walked to the first aid post without help. These facts and many more of interest are given by Dr. K. Simpson (*Lancet*, September 11, 1943) in what he claims to be the first detailed scientific record of this very rare type of accident. The paper records the results of autopsies done on the instructions of the Coroner on four selected cases and discusses the causes of the deaths. Simpson points out that the factors causing sudden deaths in the early stages of asphyxia are little recognized; such deaths are usually accidental or due to criminal action and can scarcely be reproduced for quiet physiological experiment.

The causes of the deaths of these people were found to be complex. The author points out that asphyxia is not a simple problem. The word means pulseless (from the Greek, *a-sphuxia*), and not prevention of breathing. Three of the cases autopsied showed changes quite out of keeping with prolonged asphyxia. Among other factors that may operate in such accidents are direct compression of the abdomen or chest, constriction of the neck, concussional head injuries, inhalation of vomit and "emotional, reflex neurogenic, local cardiac and more general tissue changes". Parallel factors operate in criminal strangulation and the author discusses these. People may die suddenly at the sight of approaching death or danger or even when they receive bad news or anticipate asphyxia. Impaction of food at the glottis or of water in drowning, garotting, strangling, blows or kicks on the neck, even a brisk current of cold air on the neck, may, in certain individuals, stimulate the carotid sinus reflex and, through this, may cause vasovagal arrest of respiration and the circulation. Bruises and violent hyperextension of the neck, inhalation of vomit, crushing of the chest or abdomen and similar injuries had occurred in the cases autopsied. The author adduces evidence of the rapidity with which local biochemical changes in the heart muscle and in the blood chemistry may occur in asphyxia. When some or all of the factors indicated above are operating together, death can occur very quickly, perhaps within thirty seconds. Apart from the public and biological interest of this paper, it should have, as the author indicates, considerable forensic value.

International Bird Preservation

A JOINT meeting of the British and Polish Sections of the International Committee for Bird Preservation was held in the hall of the Royal Geographical Society on September 25 with Mr. David Seth-Smith in the chair. Dr. Jul. Borucki, representing the Polish Section, spoke on the work for bird preservation done in the past in Poland, directing attention to the fact that Poland and Czechoslovakia set an example to the world by the establishment of the international reserve in the High Tatras. He spoke of the work of reconstruction which would be needed after the War and the peculiar problems of bird preservation which would have to be faced. In a message, Count Wodzicki, chairman of the Polish Section (now Consul-General in New Zealand) stressed the close links which had always existed between the British and Polish Sections; links which had been made closer by the British Section adopting the Polish Section for the duration of the War, an act which symbolized a tribute to the Polish naturalists who had not only lost property and all the results of their scientific work but also their lives.

Mr. Walter E. Higham showed his magnificent colour film of British birds. He took his representa-

tive and international audience all over Great Britain, showing in the most exquisite photography different types of landscapes and the birds that are found there: from a typical English garden to the moors and mountains of Scotland, the Lake District, woodlands, fields and hedgerows, the fens, sandy shores and rocky coasts—a film which indeed demonstrates the glories of Britain to the foreigner and should justly make any Briton proud. About thirty species of birds were represented, all of such beauty that it is difficult to make any special mention, but the shots of a shelduck feeding in a shallow pool and reflected in the water are perhaps the highest achievement gained by any Nature photographer. The Belgian Ambassador, in moving a vote of thanks to Mr. Higham, stressed the value of international co-operation in Nature preservation; he mentioned in particular the International Conference on the Preservation of the Fauna of Africa and the proposed conference for the preservation of the fauna of the Pacific, which had to be abandoned on the outbreak of war.

A Part-time Education Scheme

We have received a copy of an illustrated booklet which is handed to every boy on entering the service of W. T. Henley's Telegraph Works Co., Ltd., and Henley's Tyre and Rubber Co., Ltd. This booklet outlines a scheme which is intended to enable all youths joining the Henley organization to see how they can train themselves for their careers. Every boy is given the option of undertaking a course of training extending over a period of years. Those who have shown that they can benefit from such privileges and have been accepted for the course are released one day a week from their normal works duties to attend approved classes at selected educational institutions near to their place of employment. They are expected to devote themselves wholeheartedly to the courses laid down for them during this day, and to attend a recognized educational establishment of their own choosing on at least one other evening in the week, for which purpose, wherever practicable, they will be released from shift-work or overtime. In addition, they must undertake to carry out the homework in connexion with their day course to the satisfaction of the education authorities. The subjects selected for the day periods are of a more serious and fundamental nature, but a good deal of freedom is given in the selection of subjects for the evening courses. Boys are paid for the time spent at the day establishment, and all fees, both for the day and evening courses, are paid by Henley's. The scheme is intended to produce better workmen, foremen and managers, and also better citizens; in addition to every encouragement being given to the boys to enlarge their mental outlook, physical training classes form an important part of the scheme.

Production of Crop Seeds

The supply and distribution of seeds of agricultural and horticultural crops has been a problem of major concern since 1939 for countries isolated from Central Europe. The developments that have taken place in their attempt to achieve self-sufficiency in this respect are described in Joint Publication No. 5 issued by the Imperial Bureaux, "The Production of Seed of Root Crops and Vegetables" (price 3s.). The creation of the sugar beet industry in the United States market is perhaps the most complete of the accounts published, for it can now meet domestic needs, whereas during 1932–34 dependence on imported seed was absolute. Good results have been obtained with vegetable seed production in Sweden, and provided the right areas are selected the prospect seems promising in Australia, New Zealand and Canada. As regards Great Britain considerable progress has been made, and although Scotland appears to be outside the limits of economic seed production for all but a few vegetable crops, in England the chief advances lie in determining those areas where maximum seed yield can be expected. An interesting development is the investigation into the possibilities afforded by the tropical highlands and by those parts of the Empire which lie in the Mediterranean basin. Much information is provided on the varieties used, seed laws and regulations, and a useful index of crops and varieties is appended. Specialists or members of recognized scientific institutions who are in need of more complete references to the literature on any given section, or of more detailed information on special points, are invited to apply to the Imperial Agricultural Bureaux at East Malling, Aberystwyth or Cambridge.

Earthquakes in Central and South America

The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has found the epicentres of three recent earthquakes in Central and South America. The first, on June 30, occurred at 20h. 13·0m. U.T. from an epicentre near lat. 14·5° S., long. 74° W., which is just north of the town of Corocoro in Peru. The focus may have been deeper than normal. The second, on July 4, occurred at 9h. 52·1m. U.T. from an epicentre near lat. 9° N., long. 84·5° W., which is near the coast south-east of the town of San José, and due south of the volcano Irazu in Costa Rica. The depth of focus in this instance was possibly 100 km. The third earthquake was on July 5 at 21h. 7·6m. U.T. from an epicentre lat. 17·5° S., long. 73° W., which is immediately off the coast west of the town of Mollendo in Peru. The depth of focus was normal. All these epicentres are in well-known seismic areas and all interpretations and determinations are tentative. Calculations were based on instrumental reports from the seismological observatories at Georgetown, Weston, St. Louis, Pasadena, Philadelphia, Fordham, Tucson, San Juan, Washington D.C., Burlington, Mobile, Buffalo, and Salt Lake City.

Parsons Memorial Lecture

The Parsons Memorial Fund, which is administered by the Royal Society, made provision for a memorial to the late Hon. Sir Charles Parsons in Westminster Abbey, and for an annual Parsons Lecture to be given under the auspices of eight specified institutions and societies in turn which are concerned with the subjects most closely associated with Parsons' name. In accordance with the terms governing the appointment of the lecturers, the 1943 lecture, which is the eighth of the series, is to be given under the auspices of the Physical Society. It will be delivered at the meeting of the Society at the Royal Institution at 4.30 p.m. on October 15, by the Right Hon. Lord Rayleigh, who has chosen as his subject "Optical Topics, in part connected with Charles Parsons". Previous lectures have dealt more especially with other aspects of Parsons' work.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Interpretation of Patterson Diagrams

THE direct F^2 Fourier series of Patterson[1] is one of the most powerful methods in modern crystal analysis, and many of its applications have been described from time to time in NATURE[2]. Patterson's original result was derived as an extension of the application to crystals of the theory of scattering of X-rays in liquids made by Gingrich and Warren[3]. Patterson computes the weighted average distribution of electron density ρ about a point in the crystal, cell-size *abc*, volume v, by the relation

$$A(uvw) = \frac{1}{v}\int_0^a\int_0^b\int_0^c \rho(xyz)\rho(x+u, y+v, z+w)\,dx\,dy\,dz,$$

which gives the distribution about the point as a function of the parameters uvw. Making use of the usual expression for the electron density in terms of the structure amplitudes $F(hkl)$, namely,

$$\rho(xyz) = \frac{1}{v}\Sigma\Sigma\Sigma F(hkl)\exp 2\pi i(hx/a+ky/b+lz/c),$$

the function $A(uvw)$ is obtained as

$$A(uvw) = \frac{1}{v^2}\Sigma\Sigma\Sigma |F(hkl)|^2 \exp 2\pi i(hu/a+kv/b+lw/c).$$

The importance of $A(uvw)$ arises because it will only be large when there are high values in $\rho(xyz)$ both at (xyz) and at $(x+u, y+v, z+w)$. Thus a peak in the function $A(uvw)$ at $(u_1v_1w_1)$ corresponds to an interatomic distance in the crystal defined by a vector the components of which are $(u_1v_1w_1)$.

The success of the method, of course, depends on the fact that the distributions $A(uvw)$, or vector maps, can be calculated *directly* from the crystal measurements, because they only involve the square of the structure amplitudes, which can be directly observed.

Although very useful in dealing with simple structures with only a few outstanding features, the Patterson method becomes involved when applied to structures with large numbers of similar atoms, such as organic structures in general, owing to the excessively large number of interatomic vectors the peaks of which mutually obscure one another in the calculations and defy resolution. The following simple technique has been devised in an attempt to deal with this situation.

It is convenient to restate the Patterson result in very simple terms. Consider a linear arrangement of atoms, co-ordinates $\theta_1, \theta_2 \ldots \theta_n$ ($\theta = \frac{2\pi x}{a}$, where a is the axial length). If F_h is the structure amplitude for the hth order, then,

$$|F_h|^2 = (f_1\cos h\theta_1 + f_2\cos h\theta_2 + \ldots + f_n\cos h\theta_n)^2 + (f_1\sin h\theta_1 + f_2\sin h\theta_2 + \ldots + f_n\sin h\theta_n)^2,$$

f_n being the atomic scattering factor appropriate to the nth atom for the plane h. Expanding the terms in the brackets we obtain, with a slight rearrangement,

$$\begin{aligned}|F_h|^2 = {} & f_1f_1\cos h(\theta_1-\theta_1) + f_1f_2\cos h(\theta_1-\theta_2) + \ldots + f_1f_n\cos h(\theta_1-\theta_n) \\ & + f_2f_1\cos h(\theta_2-\theta_1) + f_2f_2\cos h(\theta_2-\theta_2) + \ldots + f_2f_n\cos h(\theta_2-\theta_n) \\ & + \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \\ & + f_nf_1\cos h(\theta_n-\theta_1) + f_nf_2\cos h(\theta_n-\theta_2) + \ldots + f_nf_n\cos h(\theta_n-\theta_n).\end{aligned}$$

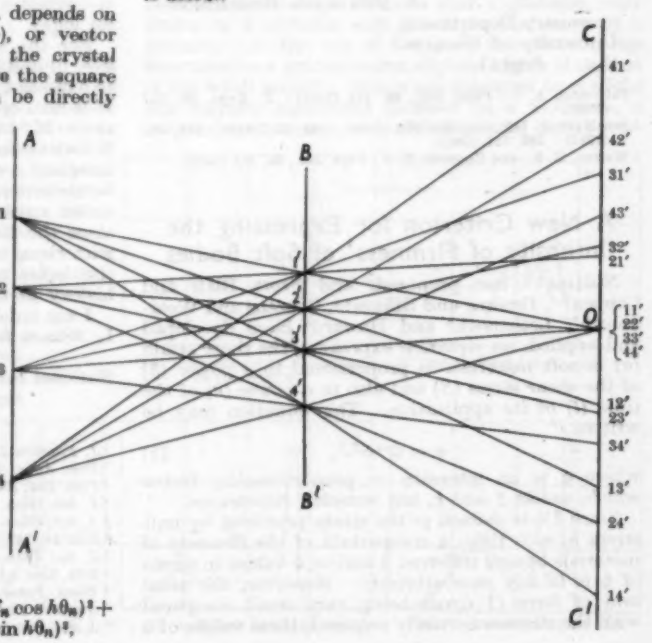
We note that the cosine terms contain all the interatomic distances in the structure, and that the coefficient of each term is the product of the atomic scattering factors appropriate to the pair of atoms concerned. This is, in effect, the Patterson result. Instead of a distribution of atoms or scattering centres, $\rho(x)$, we have to consider a distribution of interatomic vectors, $A(u)$. If this is represented by a Fourier series in the usual way, then the coefficients are $|F_h|^2$, of which there is an infinite series.

If the atoms are numbered 1, 2, . . . n, as above, the array of vectors may be written

$$\begin{matrix} u_{11}\ u_{12} \ldots u_{1n} \\ u_{21}\ u_{22} \ldots u_{2n} \\ \ldots\ldots\ldots \\ u_{n1}\ u_{n2} \ldots u_{nn} \end{matrix}$$

The diagonal terms $u_{11}, u_{22}, \ldots u_{nn}$ express the condition that every atom is at zero distance from itself, and the other terms u_{12}, u_{21}, etc., occur in symmetrical pairs. There are thus only $\frac{n(n-1)}{2}$ terms which are essentially distinct. Nevertheless, this is a large number even for structures containing only a moderate number of atoms, and consequently there is little hope of locating the individual peaks in the Patterson diagram.

In this connexion the following simple construction is useful.



The points 1, 2, 3, 4 on AA' in the diagram are joined by straight lines to the point O on the parallel line CC'. The intersections, 1′, 2′, 3′, 4′, on some intermediate parallel line BB' are marked. A line is then drawn from each point on AA' to each point on BB' and produced to CC'. The array of points on CC' is then the vector map of the points on AA'. The construction is equally valid in two dimensions, with the points distributed on planes at AA', BB', and CC'.

If the points 1, 2, 3, . . . are movable light sources connected by thin elastic threads to O, and each thread carries a small light sphere at BB', then the shadow pattern produced on the screen at CC' corresponds to the Patterson projection of the structure at AA'. The shadows will overlap and merge in some places, and in particular there will always be an intense shadow at the origin O, as in the Patterson distributions. The shadows can be adjusted to correspond very roughly to atomic contours by varying the size and intensities of the light sources.

The advantage of the method lies in the fact that as the atomic positions on AA' are varied, the resulting Patterson projection can be followed continuously. Now, the Patterson projection of any unknown structure can be calculated directly. To solve the structure, therefore, we have to vary the possible atomic positions until a good 'fit' is obtained. It is only rarely, of course, that one can deal with a small isolated group of atoms, as shown in the diagram. In general, parts of the adjoining unit cells will have to be included.

The method seems to have distinct possibilities in dealing with structures containing moderate numbers of similar atoms, and it is also an interesting lecture experiment. It is possible to abolish the rather troublesome threads and small spheres by using properly placed photographic plates and negatives, and the method outlined above also has the virtue of continuous variation.

J. MONTEATH ROBERTSON.

Chemistry Department,
University of Glasgow.
Sept. 1.

[1] Patterson, A. L., *Phys. Rev.*, **46**, 372 (1934); *Z. Krist.*, **90**, 517 (1935).
[2] See NATURE, **142**, 581, 955, 994 (1938); **143**, 75 (1939); **149**, 491 (1942); **150**, 324 (1942).
[3] Warren, B. E., and Gingrich, N. S., *Phys. Rev.*, **46**, 368 (1934).

A New Criterion for Expressing the 'Intensity of Firmness' of Soft Bodies

Nutting[1,2] has proposed, and Scott Blair and Coppen[3,4], Broome and Bilmes[5,6], Couzens and Wearmouth[7], Lethersich[8] and Haward[9] have developed and applied, an equation expressing the shear strain (σ) in soft materials as proportional to a power (β) of the shear stress (S) and also to a power (k) of the time (t) of its application. This equation may be written:

$$\sigma = \psi^{-1} S^{\beta} t^{k}, \qquad (1)$$

where ψ is an intensity or proportionality factor which, unlike β and k, has complex dimensions.

Since $1/\psi$ is defined as the strain produced by unit stress in unit time, a comparison of the firmness of materials having different β and/or k values in terms of ψ is in any case arbitrary. Moreover, the usual unit of force (1 dyne) being very small compared with the stresses normally required, these values of ψ are not only arbitrary but are apt also to be misleading. Although this latter difficulty can be obviated by using a larger unit of force, ψ still represents no more than a point within a three-dimensional diagram.

The intensity factor cannot, in the nature of things, be expressed in terms entirely independent of arbitrary conditions: but a great improvement can be effected if we use, for purposes of comparison, instead of ψ, a property ζ, defined as the reciprocal of the volume of the $S : \sigma : t$ figure integrated between the limits of the greatest ranges of stress and time likely to be used in practical testing.

As an example, for materials which are readily deformed by squeezing in the hands ("soft bodies"), Scott Blair and Coppen[10] have shown that stresses of the order of 10^6 dynes/cm.^{2} are normally exerted. For studying such materials, a convenient range of stress would be 0–10^6 dynes/cm.^{2} and of time 0–100 sec.

Indicating these limits by their logarithms as suffixes, we have, for the volume of the selected figures:

$$1/\zeta = \int_0^{S_1} \int_0^{t_1} \sigma . dS . dt. \qquad (2)$$

Substituting from equation (1) and integrating:

$$1/\zeta = \psi^{-1} \frac{1}{\beta+1} \cdot \frac{1}{k+1} S_1^{\beta+1} t_1^{k+1};$$

or, writing σ_m for maximum strain and taking logarithms:

$$\log \zeta = \log(\beta+1) + \log(k+1) - 8 - \log \sigma_m \qquad (3)$$

Log σ_m can either be determined experimentally or, more usually, calculated from experimental data for lower values of S and t, using equation (1).

Scott Blair and Caffyn's[11] suggestion that the deformation properties of soft materials should be described by plotting log ψ vertically on the base of a 'Nutting square' having β and k as horizontal co-ordinates is thus improved by substituting log ζ for log ψ.

For the special cases of an elastic solid ($\beta = 1$, $k = 0$) and a viscous fluid ($\beta = 1$, $k = 1$) it is easy to express ζ in terms of shear modulus and viscosity. It is not, of course, a fluidity, in spite of its dimensions ($M^{-1}LT$), which are independent of equation (1). Notwithstanding the necessity for fixing limits in the integration defining ζ, this treatment often provides better criteria of the behaviour of complex materials under stress than do viscosities and shear moduli, since the former usually fall in a complex manner with rising stress and rise with increasing strain, and the latter are frequently dependent on the stress history of the sample.

I am indebted to Dr. F. M. V. Coppen and to Mr. L. Bilmes for helpful discussions.

G. W. SCOTT BLAIR.

National Institute for Research in Dairying,
Shinfield, Near Reading.
Aug. 19.

[1] *J. Franklin Inst.*, **191**, 679 (1921).
[2] *Proc. Amer. Soc. Test. Materials*, **21**, 1162 (1921).
[3] *Proc. Roy. Soc.*, B, **128**, 109 (1939).
[4] *J. Soc. Chem. Ind.*, **60**, 190 (1941).
[5] *J. Soc. Chem. Ind.*, **60**, 184 (1941).
[6] NATURE, **147**, 176 (1941); **149**, 412 (1942).
[7] *J. Soc. Chem. Ind.*, **61**, 69 (1942).
[8] Brit. Elec. and Allied Ind. Res. Assoc. Report No. L/T 14.
[9] *Trans. Farad. Soc.*, **38**, 394 (1942).
[10] *Amer. J. Psychol.*, **55**, 215 (1942).
[11] *J. Sci. Instr.*, **19**, 88 (1942).

Structure of the Eta Phase of the Iron-Silicon System

THE crystal structures of the different phases of the iron-silicon system have been worked out by Phragmen[1] with the exception of one, which he described as Fe_2Si_3 (25·0 per cent Si). This phase usually appears together with α (solid solution of silicon in ferrite) or ε (FeSi). The composition seems to correspond to 23–25 per cent Si, but it is difficult to obtain it in a pure form. Furthermore, Greiner and Jette[2] showed that the η phase was stable only between 825 and 1030° C.

Osawa and Murata[3] described this phase as Fe_2Si_3 (23·1 per cent Si) and succeeded in indexing the lines on the basis of a hexagonal unit cell with:

$$a = 6{\cdot}727_8\ \text{kX.},\quad c = 9{\cdot}411_2\ \text{kX.},\quad \frac{c}{a} = 1{\cdot}398_8.$$

Experimental work carried on here supports their conclusions except that we find the c axis to be only half this length[4].

It was then realized that the powder photographs of Mn_3Si_3 and Fe_2Si_3 show a great similarity. Comparative measurements of spacing, as well as observation of intensities, confirmed this analogy.

The structure of Mn_3Si_3 has been elucidated by Amark, Borén and Westgren[5]; the space group is D_{6h}^3 (C 6/mcm), and not that previously suggested[4]. The unit cell contains $Mn_{10}Si_6$. The accompanying table gives the particulars of the Mn_3Si_3 and Fe_2Si_3 structures:

	Lattice parameters			Structural parameters[6]		
	a (kX.)	c (kX.)	$\frac{c}{a}$	4 Mn (or Fe) in (d)	6 Mn (or Fe) in (g) $u = 0{\cdot}23$	6 Si in (g) $v = 0{\cdot}60$
Mn_3Si_3	6·898 ± 0·005	4·802 ± 0·005	0·696	$\frac{1}{3}\ \frac{2}{3}\ \frac{1}{4}$	$u\ u\ 0$	$v\ v\ 0$
Fe_2Si_3	6·7416 ± 0·0006	4·7079 ± 0·0006	0·69834			

The reason why this similarity has not been noticed before is probably that different authors found some difficulties in deriving the right formula for the phase. Borén[7] studied by X-rays the alloys of silicon with chromium, manganese, cobalt and nickel. He observed the hexagonal phase in the Mn-Si system, but did not remark its similarity with the eta phase of the iron-silicon system. He attributed to the manganese-silicon phase the formula Mn_3Si, while the eta phase of the iron-silicon system was described as Fe_2Si_2. Actually, it now appears certain that they should be described as Mn_3Si_3 and Fe_2Si_3 respectively.

The analogy between the two systems is now evident, as the following comparison shows:

Mn_3Si is a body-centred phase ($a = 2{\cdot}851$ kX)[8].

Fe_2Si, or the region of the continuous solid solution of silicon in iron corresponding to this particular composition, is also body-centred ($a = 2{\cdot}8220$ kX. ± 0·0003).

Mn_3Si_3 and Fe_2Si_3 are isomorphous, as described above.

MnSi (cubic, $a = 4{\cdot}548$ kX. ± 0·002)[9] has the same structure as FeSi ($a = 4{\cdot}4790$ kX., the lattice parameter varying with the composition).

The structure of the eta phase was the only unknown one in the iron-silicon system, which is now completely worked out from the crystallographic point of view.

Approval for publication has been given by the Director-General of Scientific Research and Development, Ministry of Supply.

A. R. WEILL.

Cavendish Laboratory,
Cambridge. Aug. 21.

[1] Phragmen, *J. Iron and Steel Inst.*, **114**, 394 (1926).
[2] Greiner and Jette, Amer. Inst. Min. Met. Eng., T.P. No. 744 (1936).
[3] Osawa and Murata, *Nippon Kinzoku Gakkai-Si*, **4**, 228 (1940).
[4] Lipson and Weill, *Trans. Farad. Soc.*, **39**, 13 (1943).
[5] Amark, Borén and Westgren, *Metallwirtschaft.*, **15**, 835 (1936).
[6] International Tables for the Determination of Crystal Structures, vol. 1, 229 (1935).
[7] Borén, *Arkiv. för Kem. Min. Geol.*, **11**, A, No. 10 (1933).
[8] Laves, *Z. Krist.*, **89**, 189 (1934).

Variation of Serum Composition with the Age of Horses as shown by Electrophoresis

THE results briefly reported below became apparent during the course of systematic examination of samples of sera from a wide variety of sources. A simple modification[1] of the Tiselius electrophoresis apparatus[2] was used in conjunction with the Lamm scale method[3] of recording the migration of the serum components. On the graphs obtained the approximate area of that portion of the curve representing a particular component was measured and the figures expressed as percentages of the total protein. The protein concentrations are given in the table below.

It is apparent that serum of the newly born foal with a relatively low total protein content is characterized by a high albumin and α globulin, only traces of β globulin and a complete absence of γ globulin. At the age of five days the albumin has decreased to a concentration slightly higher than that of the adult animal; this is accompanied by a slight but scarcely significant increase in α globulins, a tremendous increase in β globulins and the appear-

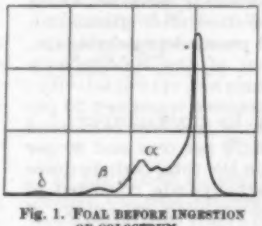


Fig. 1. FOAL BEFORE INGESTION OF COLOSTRUM.

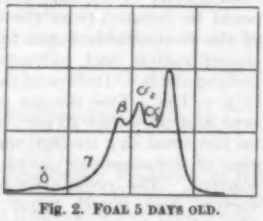


Fig. 2. FOAL 5 DAYS OLD.

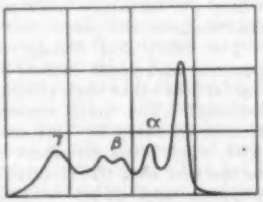


Fig. 3. FOAL 8 MONTHS OLD.

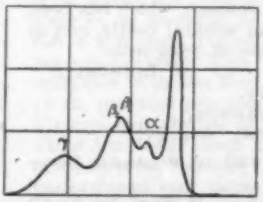


Fig. 4. HORSE 2½ YEARS OLD.

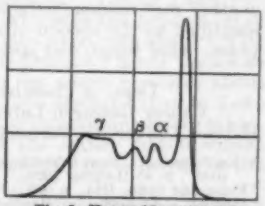


Fig. 5. HORSE 10 YEARS OLD.

Age of horse	Percentage of total protein				Protein conc.
	Albumin	$(\alpha_1+\alpha_2)$ glob.	$(\beta_1+\beta_2)$ glob.	γ glob.	
Newly born	65	22	3	0	3·7
After 5 days sucking	37	36	25	2	5·25
Foal, 8 months	33	14	25	28	6·8
2½ years	30	11	33	26	7·0
10 years	30	11	12	47	7·0

ance of traces of γ globulins. With age the albumins decrease slightly, and the α globulins markedly, to a constant. The β and γ globulins decrease and increase respectively in marked degree so that the total protein concentration remains constant at a figure slightly less than double that of the newly-born foal.

Jameson, Alvarez-Tostado and Sortor[4] reported results on the electrophoresis of calf serum. They showed that the increase in γ globulin is very rapid during the nursing period; in other respects their results resemble the results reported in this communication.

ALFRED POLSON.

Division of Veterinary Services,
Dept. of Agriculture and Forestry,
Onderstepoort, South Africa. July 15.

[1] Polson, NATURE, 145, 27 (1940).
[2] Tiselius, *Biochem. J.*, 31, 313 (1937).
[3] Lamm, *Z. Phys. Chem.*, 138, 313 (1928).
[4] Jameson, Alvarez-Tostado and Sortor, *Proc. Soc. Exp. Biol. Med.*, 51, 163 (1942).

A New Source of Trehalose

ABOUT fifteen years ago the manna of the Sinai desert was identified by Bodenheimer and Theodor[1] as the excretion of the scales *Trabutina mannipara* and *Najacoccus serpentinus* on the leaves of *Tamarix mannifera*. Chemically, the manna was determined as a mixture of sucrose and invert sugar[2].

Recently, Prof. Bodenheimer kindly supplied me with specimens of a manna from the North Iraqian desert (Suleimanyia District). The Bedouin gather this sweet product from leaves of trees and bushes, and use it as a sugar substitute in coffee. It is a half syrupy, half crystalline mass, and is considered by Prof. Bodenheimer to be an excretion of a leaf scale. Chemical analysis showed that its sugar fraction consists mainly of the rare disaccharide trehalose, which could be isolated from the mixture after elimination of the fermentable sugar by yeast, deproteinization, concentration and extraction of the residue with boiling alcohol. It showed the correct optical activity: $[\alpha]_D + 198°$. One manna specimen contained 30 per cent and the other 45 per cent of trehalose calculated on the total dry matter, and 70 per cent and 80 per cent of trehalose calculated on the total carbohydrate content. The remaining carbohydrate consisted of sucrose and invert sugar containing an excess of glucose.

Previously, trehalose has been shown to occur in another rare manna (trehala-manna), which has been identified as the cocoon of an oriental beetle, and in yeast, other fungi, and species of Selaginella[3].

J. LEIBOWITZ.

Dept. of Chemistry,
Cancer Research Laboratories,
Hebrew University, Jerusalem. Aug. 17.

[1] "Ergebnisse der Sinai-Expedition 1927 der Hebräischen Universität", p. 45 (Leipzig, 1929).
[2] Fodor and Cohn, Ibid., p. 89.
[3] Zemplen, "Biochemisches Handlexikon", 13 (Suppl. Vol. 6), 551 (1931).

Microbiological Assay of Riboflavin

IN 1939, Evans, Handley and Happold[1] used the Strong-Snell[2] method to demonstrate the synthesis of riboflavin, among other elements of the B complex, by *C. diphtheriæ*, and early in 1940 I demonstrated to the Biochemical Society the Strong-Snell technique for the assay of this component. In further studies we became aware of certain pitfalls in the application of this method; our observations being communicated to fellow investigators at a symposium held in Reading a year ago.

Since then full papers on the microbiological assay of riboflavin by Barton-Wright and Booth[3] and by F. W. Chattaway and Mary Sandford and myself[4] have appeared. The formers' paper, which appeared first, does not mention at least two facts of importance which must be considered before the original method of Strong and Snell can be applied, namely, the importance of the calcium level of the medium, and of the additional growth factors which must be present in the medium in optimal proportions. Both of these points have been conceded in private conversation. It is therefore to be regretted that in their recent communication to NATURE[5] which appears simultaneously with that of Prof. Hopkins[6] there is no mention of these particulars. It seems a pity that we should run the risk of discrediting a potentially valuable line of approach to the rapid assay of the vitamins of the B complex by failing to indicate to all workers in this field the necessity for careful and critical scrutiny of the methods in use before we apply them in a wholesale fashion to the analysis of foods and body fluids and secretions.

FRANK C. HAPPOLD.

Biochemical Laboratories,
School of Medicine,
Leeds, 2.
Sept. 14.

[1] Evans, W. C., Handley, W. R. C., and Happold, F. C., *Brit. J. Exp. Path. and Bact.*, 20, 396 (1939).
[2] Snell, E. E., and Strong, F. M., *Ind. Eng. Chem.* (Anal. ed.), 11, 346 (1939).
[3] Barton-Wright, E. C., and Booth, R. G., *Biochem. J.*, 37, 25 (1943).
[4] Chattaway, F. W., Happold, F. C., and Mary Sandford, *Biochem. J.*, 37, 298 (1943).
[5] Barton-Wright, E. C., Moran, T., and Sarson, H. S., NATURE, 152, 273 (1943).
[6] Hopkins, R. H., NATURE, 152, 274 (1943).

DR. HAPPOLD has shown us a copy of his letter criticizing the microbiological assay of riboflavin by our modification of the Snell and Strong[1] method. Had his criticisms been raised against the assay of pantothenic acid using *Lactobacillus helveticus* or nicotinic acid using *L. arabinosus* (Snell and Wright[2]) we would have been in partial agreement, but as regards riboflavin assay they have no justification.

Further, we would point out that our paper was submitted for publication a fortnight before the Reading symposium (held September 25, 1942), while we certainly have never conceded in private conversation the point that Dr. Happold raises.

The Snell and Strong medium uses photolysed peptone and yeast extract for the necessary remaining factors other than riboflavin required in optimum amount. The main reason for the success of the riboflavin assay by this method and lack of success with some other members of the B_2 complex is due to the fact that the riboflavin is easily removed from peptone and yeast without destroying the other factors. Peptone itself contains an unknown factor

which is required in high concentration by *L. helveticus* and also *L. arabinosus* and *Streptococcus lactis* (Pollack and Lindner[3], and our own unpublished observations). Our main difficulty, for example, in the microbiological assay of nicotinic acid has been to free the peptone of its nicotinic acid without at the same time removing this unknown factor.

Chattaway, Happold and Sandford[4] have described a 'synthetic' medium using hydrolysed casein in place of peptone for the assay of riboflavin, and have stressed the need for Ca^{++} to be present. This medium, however, suffers from the fundamental defect that it contains no sodium acetate, and is therefore insufficiently buffered (Stokes and Martin[5] and our own unpublished observations). In so far as calcium chloride is a very much less satisfactory buffer than sodium acetate it fails to maintain the desirable *p*H for optimal growth and acid production—if a suitable amount of sodium acetate be present in the medium the presence of Ca ions has no effect one way or the other on the titrations.

Further evidence for the inadequacy of the medium used by Chattaway *et al.* is shown (1) by the fact that they were unable to obtain satisfactory values for the riboflavin content of certain foodstuffs; (2) the fact that its sensitivity in response to added riboflavin is very low—0·1–0·8 μ gm./10 ml. medium, cf. Fig. 1 (Chattaway *et al.*) with a maximum titration of 6 ml. *N*/10 NaOH. With the Snell and Strong medium the range of riboflavin used varies from 0·05 to 0·2 μ gm. and the maximum point is reached at 0·25 μ gm. The titration value here is between 17 and 18 ml. *N*/10 NaOH/10 ml. of medium.

Finally we would point out that it can scarcely be mere coincidence that assays carried out by the microbiological, fluorometric and biological methods on the same material all agree within experimental error (Barton-Wright and Booth[1], Copping[6]). This agreement has since been extended to mixed diets, the results of which will shortly be published.

E. BARTON-WRIGHT.
R. GORDON BOOTH.

Cereals Research Station,
Ministry of Food,
Old London Road,
St. Albans.
Sept. 18.

[1] Barton-Wright, E. C., and Booth, R. G., *Biochem. J.*, **37**, 25 (1943).
[2] Snell, E. E., and Wright, L. D., *J. Biol. Chem.*, **139**, 675 (1941).
[3] Pollack, M. A., and Lindner, M., *J. Biol. Chem.*, **147**, 183 (1943).
[4] Chattaway, F. W., Happold, F. C., and Sandford, M., *Biochem. J.*, **37**, 298 (1943).
[5] Stokes, J. L., and Martin, B. B., *J. Biol. Chem.*, **147**, 483 (1943).
[6] Copping, A. M., *Biochem. J.*, **37**, 12 (1943).

An Alumina Hydrogel

SOLS of hydrous alumina are generally prepared either by the hydrolysis of aluminium acetate solutions, or by the peptization of freshly precipitated hydrous alumina. Such sols are converted to gels by the addition of a suitable small amount of electrolyte, and the gels so formed are thixotropic at concentrations so low as 1 per cent Al_2O_3 [1].

Pavelka[2] prepared an alumina sol by the addition of ammonia to an aluminium salt in the presence of boric acid. The following discussion shows how an alumina gel may be formed in the presence of boric acid without the addition of ammonia. The gel is formed simply by cooling a sol of suitable composition, as in the typical preparation of an organic jelly.

In the course of the colorimetric determination of silica in alumina, the alumina was brought into solution by fusion with a mixture containing 2 parts of sodium potassium carbonate to 1 part of anhydrous borax. The melt was afterwards extracted with water, and the aqueous solutions, under certain conditions of concentration and *p*H, were found, on standing, to be converted into gels which exhibited, to a slight extent, the phenomenon of thixotropy.

If a solution containing 4·45 gm. of Al_2O_3 and 17·8 gm. of fusion mixture in 100 ml. was allowed to stand in the cold, it was converted into a gel which, on shaking, was transformed to a viscous liquid. More concentrated solutions (5 gm. Al_2O_3 and 20 gm. of fusion mixture in 100 ml.) formed a brittle gel which became pasty on stirring. If left undisturbed, these gels soon regained their original firmness.

The sol-gel transformation is reversible, since, on warming, the gels were converted into sols. The time required for the cooled sols to be reconverted into gels was found to depend on their concentration. If the most concentrated sol was allowed to stand, a cloudiness and increase in viscosity was observed after half an hour, and the mixture set to a firm gel after an hour. If this sol was diluted to 2·5 times its original volume, so that it contained 2 gm. of Al_2O_3 and 8 gm. of fusion mixture in 100 ml., the cloudiness appeared after three hours and gel formation was complete after forty hours; if the solution was further diluted so as to contain 1·33 gm. of Al_2O_3 and 5·33 gm. of fusion mixture in 100 ml., the cloudiness appeared after twenty-four hours and a gel was formed after four days. All these gels suffered a marked decrease in viscosity on shaking.

In the most concentrated solutions a deposition of boric acid occurred, but this did not prevent gel formation.

The stability of these concentrated gels to acid was also investigated by acidifying the sol with nitric acid and testing its *p*H by means of the glass electrode before gel formation commenced. In this way it was found that a sol with *p*H so low as 2·4 was converted into a gel in the usual way. Addition of more 8 *N* nitric acid brought about the permanent destruction of the gel.

F. C. JOHNSON.

Department of Chemistry,
University of Western Australia.

[1] Freundlich and Bircumshaw, *Kolloid-Z.*, **40**, 19 (1926); Freundlich, **46**, 294 (1928).
[2] *Kolloid-Z.*, **84**, 303 (1938).

Production of Freshwater Fish in Palestine

IN his article on the "Freshwater Fisheries in the British Colonial Empire"[1], Dr. E. B. Worthington stresses the importance of freshwater fish production, but points out that in many parts of the Empire the fresh waters are being neglected. Taking Lake Victoria as an example, he estimates the production of fish in this great tropical lake to be only about 1·4 lb. per acre per year. This "ridiculously small" figure he compares with the North Sea which produces about 15 lb. per acre per year, and explains that in Lake Victoria only the fish of the inshore waters are taken, while the main mass of the water, 26,800 square miles in area, but less than 270 ft. in depth, is left undeveloped and unexploited.

It is interesting to compare these figures with those

of Palestine where the fresh waters so far provide one quarter of the total fish production of the country. Apart from the Dead Sea, the largest area of inland water is Lake Tiberias (Sea of Galilee), which is a small, shallow sub-tropical lake, with an area of about 65 square miles and a depth of less than 160 ft. Despite the fact that the Lake has recently been seriously overfished, the catch during 1942–43 was 420 tons. This is a production of 22·5 lb. per acre per year, a figure about seventeen times as high as that of Lake Victoria. Investigations on the composition of this catch show that 76 per cent of the total was contributed by a small open-water cyprinid, *Alburnus sellal*, commonly known as 'sardine'. This little fish appears in the fishery only during four months of the year and is rarely taken above a length of 12 or 13 cm. The remaining 24 per cent of the catch was made up of three large species of Cyprinidæ and five species of Cichlidæ (Tilapia species and related genera) all of which are caught around the shores. If the catches of these inshore fish are considered separately, they show a production of 5·4 lb. per acre, a figure still nearly four times that of Lake Victoria.

The part played by the 'sardines' in the Lake Tiberias fishery is thus an extremely large one at the present time and one which has increased in importance in the last few years. In the past 'sardines' were considered of little value, and as recently as the 1935–36 and 1936–37 seasons, they contributed only 33 per cent of the total catch. The fishery then was not strictly controlled and the stock of fish was being both too intensively and irrationally fished, with the result that each year it was becoming increasingly difficult to get good catches of the larger cyprinids and cichlids. Although overfishing of these species was obviously occurring, the fact was masked in the records of the fishery since these showed a continuous increase in the total catch each year. The explanation is that as the other stocks decreased in size the fishermen turned more and more to the 'sardines' until three quarters of the catch was composed of them. This trend has been accentuated and accelerated by the new restrictions and regulations which were introduced into the fishery in 1942 to protect the stocks of the larger cyprinids and cichlids from destruction. These restrictions, as was expected, reduced markedly the catches of these fishes during the year 1942–43, making even more men concentrate on 'sardine' fishing. Luckily from the point of view of food production, the fantastic prices which the public of Palestine is willing to pay for fish of all kinds has encouraged the fishermen to work harder, so that the catch from the lake has not gone down as a result of the new legislation. Even the 'sardine', once spurned by all but the fellahin, is now in universal demand, and the other main species may realize more than two shillings a pound when landed on the quay.

The only other considerable area of natural fresh water in Palestine is Lake Huleh and its surrounding swamps. Last year this area produced 45 tons of fish. It is difficult to give a figure for production since the boundaries between open water, swamp and dry land are not clearly defined and vary greatly with the seasons. Taking the average area of water which can be inhabited by fish during the year to be not less than 9 square miles, the production is less than 5 lb. per acre per year. Since Lake Huleh is a shallow lake, rich in food, it is surprising to find that at present it is probably yielding less per acre than the inshore waters of the much more barren Lake Tiberias and only about one quarter of the total production of that Lake. In Lake Huleh more extensive cutting of channels in the weed beds is required if the fishery is to give its proper yield.

Turning to the subject of fish ponds, it is again interesting to compare the production in Palestine with that in other countries. In central Europe Dr. Worthington says that "fish farms may produce up to and more than 400 lb. of fish, such as carp and rainbow trout, per acre of water per annum". In Palestine exact figures are impossible as the industry is expanding rapidly, but during last year there were not less than 500 acres of fish ponds in existence which produced more than 200 tons of carp. The production, therefore, is between 800 and 900 lb. of fish per acre per year, which is at least twice as high as that of central Europe. This high figure results from the fact that carp grow very rapidly in the climate of Palestine. They become mature in a few months instead of in two years as in Europe, and may grow from the egg to a weight of more than four pounds in a year.

C. K. RICARDO BERTRAM.

Fisheries Office,
Haifa, Palestine.
July 5.

[1] NATURE, 151, 353 (1943).

Polyploidy in the Potato

RECOGNITION of the polyploid nature of various economic plants has become increasingly important, and the type of polyploidy is also of prime importance in the study of phylogeny within any genus or family of plants. Various cytological and genetical criteria of polyploidy have been used, such as chromosome number, the number of nucleoli, polyvalent chromosomes in diakinesis, and tetraploid segregation ratios of genetic characters. In many plant genera, chromosome number together with the number of satellites, secondary constrictions and nucleoli (and where available with additional points in chromosome size and morphology) are sufficient to show the type of polyploidy and in some cases to provide adequate evidence as to how it has arisen[1]. In the genus Brassica, even the ancestral species have thus been clearly recognized in several cases[2].

In some genera, however, the distinction between allo- and autopolyploidy is difficult to make, even when considerable information, both cytological and genetical, is available. Cadman[3] and others have shown that in cultivated potatoes with $2n = 48$ chromosomes the chromosome number is probably tetraploid, but a genetical proof of auto- rather than allotetraploidy is by no means simple, partly owing to crossing-over and what has been called double reduction of the particular genes concerned. Other workers with the potato have regarded it as functionally a diploid, a view which is still not entirely excluded, although the chromosome number is evidently at least tetraploid.

In a recent note, Cadman[4] finds from 2 to 9 multivalent chromosomes in the pollen mother cells of the variety Flourball, the large majority being quadrivalent, with a few of even higher valence. As many as 8 quadrivalents were found in one cell (where 24 bivalents might be expected in a simple allotetraploid), suggesting the presence of 8 chromosomes which are at least partially represented in quadruplicate. The presence of high multivalents has also

been shown in potato varieties by other investigators, indicating segmental interchange, which is well known to be of frequent occurrence in plants, such as the potato, which reproduce mainly by vegetative methods.

While this evidence increases the likelihood of autotetraploidy in the potato, it by no means constitutes proof. Studies of the nucleoli and their relation to the satellites have given such clear evidence of allo- or autotetraploidy in many other plant genera that a similar study of nucleoli in the potato is obviously called for. If, following the Feulgen stain, a green dye is used after an alkaline mordant[5], significant results should be obtainable without difficulty.

R. RUGGLES GATES.

Marine Biological Laboratory,
Wood's Hole, Mass.
Aug. 24.

[1] Gates, R. R., *Bot. Rev.*, **8**, 337 (1942).
[2] Sikka, S. M., *Genetica*, **40**, 441 (1940).
[3] Cadman, C. H., *J. Genetics*, **44**, 33 (1942).
[4] Cadman, C. H., NATURE, **152**, 103 (1943).
[5] See Semmens, C. S., and Bhaduri, P. N., *Stain. Tech.*, **14**, 1 (1939), and later papers.

Apparent Reversal of Position of the Golgi Element in the Renal Tubule

THE work of Goormaghtigh[1] in elaborating on and extending Ruyter's discovery[2] of specialized cells in the renal arteriole, when taken along with Zimmerman's description[3] of an aggregation of the cells in the adjacent distal tubule, which Zimmerman called the *macula densa*, has introduced new terms and concepts into the histology and pathology of the kidney. It has already been shown that the tubule and the glomerulus which are in such intimate contact at the glomerular root are parts of the one nephron, and that both structures—the arteriole and tubule—seem similarly affected in disease[4]. Because of these facts and since Goormaghtigh has described both tubule and vessels as being jointly affected in several experimental procedures, we had suggested the term *juxta-glomerular complex* to serve as an all-inclusive term for these structures forming the glomerular root.

Apart from the aggregation of nuclei, distinctive features have been lacking for the cells comprising the *macula densa*. Goormaghtigh[1] described the centrosome in the *macula densa* as being situated on the side of the nucleus towards the attached pole of the cell, but other features to suggest a special function have not been described. Studies were undertaken with various techniques for the Golgi element in an attempt to supply this deficiency.

Kittens were killed rapidly with ether, and kidney blocks were prepared by the Da Fano and Mann-Kopsch (Weigl) techniques. In addition, rabbits were killed, each by a single blow on the head, and blocks of kidney tissue were prepared by the Aoyama, Champy post-osmified (Kolatchev) and Mann-Kopsch (Weigl) techniques. In every instance, the osmium preparations were of little use, whereas the silver impregnations (Da Fano and Aoyama) were quite satisfactory. It was found that toning of the sections for five or ten minutes in gold chloride (0·1 per cent containing a few drops of glacial acetic acid per 100 c.c.) appeared to increase the clarity of the images of the Golgi structures.

The appearances of the Golgi structures in the cat and rabbit kidneys are essentially similar. Without enlarging further on the appearance of these structures in the various segments of the renal tubule, suffice it to say that they were seen as granules and short rods. Their position in most tubule cells is remarkably constant, almost invariably being immediately on the lumen side of the nucleus. In the distal tubule a similar position is found except in the cells of the *macula densa*, where the position in respect to the nucleus seems to be reversed and the Golgi element appears to lie on the side of the nucleus towards the attached pole of the cell.

One will not attempt to infer any significance from this apparent reversal of the Golgi element. It may be suggested that if any autonomy existed in the blood supply of the mammalian nephron, the strategic situation for such an effect to be put into action seems to be the juxta-glomerular complex. This autonomy might consist of the regulation of the intermittency of glomerular flow, if such exists, or alteration in the pressure in and about the tubules, or in the afferent and efferent arterioles.

Further studies are in progress on the Golgi element in the kidneys of various other species and will be reported later in detail. It is felt that the cytological aspects of normal and abnormal physiology have been neglected, and that cytological techniques might add something to our information about the normal and diseased human kidney, among other organs.

I am grateful to Dr. John R. Baker of the Department of Zoology and Comparative Anatomy, Oxford, for his advice, encouragement and unfailing help in these studies; and to him and to Prof. E. S. Goodrich, through whose kindness it was possible to confirm some of this work in their department.

J. F. A. MCMANUS.

Royal Canadian Army Medical Corps
in Great Britain.

[1] Goormaghtigh, N., (Refs.) *Arch. Biol. Paris*, **51**, 293 (1940).
[2] Ruyter, J. N. C., *Z. Zellforsch.*, **2**, 242 (1925).
[3] Zimmerman, K. W., *Z. Mikr. Anat. Forsch.*, **32**, 176 (1933).
[4] McManus, J. F. A., *Lancet*, **2**, 394 (1942).

Competition for Nitrogen between the Take-all Fungus and the Roots of Crop Plants

SURVIVAL of the take-all fungus (*Ophiobolus graminis*) in buried infected cereal stubble is prolonged by an adequate supply of soluble nitrogen from the surrounding soil[1,2]. If the soil is left in clean fallow after harvesting a cereal crop affected by the take-all disease, then the ammonia and nitrate nitrogen set free by the activities of soil micro-organisms will become available to *O. graminis* in the buried infected cereal stubble, and the survival of the fungus is likely to be prolonged. But in soil under crop, much of the nitrogen thus set free will probably be taken up by the plant roots before it can reach *O. graminis*. With this possibility in mind, I have recently compared the survival of *O. graminis* in lots of 250 lengths each 1½ in. long of infected wheat straw buried in fallow soil, and in soil under trefoil, mustard, and oats, respectively. Eight weeks after burial of the infected straws in the soil, the percentage of straws containing viable mycelium of *O. graminis* (as revealed by a wheat seedling test[1]) was 68 under fallow, 18 under trefoil, 17 under mustard and 4 under oats.

Although due allowance must be made for the fact that this experiment was carried out in boxes

of soil and not in the open field, it seems safe to conclude that the take-all fungus is likely to disappear more quickly from soil under a non-susceptible crop than from soil kept fallow. This observation may explain the success of a system followed by certain English farmers for continuous barley growing. Barley is susceptible to the take-all disease, and the second or third consecutive barley crop on the same land is sometimes severely attacked. But barley undersown with trefoil (which makes a luxuriant growth in late summer and autumn after the barley has been cut, and is then ploughed in as a preparation for the next barley crop) has not so far been observed to suffer from take-all. To explain this observation, it is suggested that the active growth of the legume after barley harvest keeps the available nitrogen content of the soil at a very low level, with resulting detriment to the longevity of *O. graminis*, most of which is unable to survive until sowing of the new barley crop in the spring.

S. D. GARRETT.

Rothamsted Experimental Station,
Harpenden.

[1] Garrett, S. D., *Ann. Appl. Biol.*, **25**, 742 (1938).
[2] Garrett, S. D., *Ann. Appl. Biol.*, **27**, 199 (1940).

Vacuum Filtration of Sewage Sludge

IT is interesting to know[1] that the results of experiments on the aeration of sewage sludge, as a preliminary to coagulation and vacuum filtration, may shortly be published by the Rivers Department, Manchester.

In Great Britain, the first experiments on vacuum filtration of activated sludge appear to be those carried out at Sheffield sewage works by the late John Haworth[2], and mentioned in a paper published by him in 1923. During the discussion on this paper, it was stated that by further aeration of surplus activated sludge in separate tanks, it is possible to bring it into a condition in which a great deal of water can be drawn off and the sludge can be more easily filter-pressed.

It is unfortunate that the results of subsequent experiments at Sheffield, by Howarth and J. H. Edmondson (his successor), have not been published. The latter has been working on the subject for the past seven years and, in his early experiments, found that activated sludge is most easily filtered when in a nitrifying condition and within three to six hours after leaving the sewage purification plant. In a tentative scheme which Edmondson has prepared, it is intended to store surplus activated sludge in a bio-aeration plant, designed for the dual purposes of aeration and equalizing the flow, previous to vacuum filtration.

J. H. GARNER.
(Chief Inspector.)

West Riding of Yorkshire Rivers Board,
Wakefield.

[1] NATURE, **152**, 249 (1943).
[2] Haworth, J., Proc. Assoc. of Managers of Sewage Disposal Works (1923).

Nutritional Research in the Crown Colonies

PROF. C. M. YONGE[1] refers to the need for the establishment of a centre of marine research in the West Indies, and further, he urges the creation of a fisheries' station there, after the War.

In 1941, I wrote to the *Lancet*, putting forward a similar requirement for nutritional research centres in the Crown Colonies. As yet, they possess no such organizations, as we see, for example, in India (Coonoor) or in China (Henry Lester Institute), to say nothing of the relatively great number of research units in Great Britain. Apart from the very obvious nature and even elementary considerations of such need, the Crown Colonies—with their severe incidence of deficiency disease states out of all parallel to our own country—afford quite exceptional opportunity for sustained nutritional research, as for example, their *different* dietaries, the *different* or apparently different factors which lead up to the same expression in types of disease, in *different* races and peoples. Again we have to remember, also, all nutritional investigation we should undertake in these Colonies primarily affects the welfare of those peoples, not ourselves.

Research institutes not only afford opportunity for research, but they also provide facilities for local training within the country concerned, and they offer security of tenure for the locally trained man. Many Indians, trained at Coonoor, now are not only contributing to the solution of many of their own food problems, as they should be, but also have become well-known authorities in a much wider field. Little of such opportunity has been given to our Crown Colonies, with the comparatively few exceptions of expensively trained home men, and even so, without the full facilities, there has been little enough opportunity for sustained or inclusive research.

Similar research centres, therefore, are long overdue, not only for the West Indies but also for West Africa, East Africa and so forth.

D. FITZGERALD MOORE.

Hillside Cottage,
Corfe View Road, Parkstone,
Dorset.
Aug. 1.

[1] NATURE, **152**, 136 (1943).

James Prescott Joule and the Unit of Energy

PROF. H. S. ALLEN'S communication in NATURE of September 25 prompts me to mention a recent conversation which I had with a Manchester man whose evidence I should have considered trustworthy. He mentioned that in his youth he had known a man who had been well acquainted with Joule, and that he had told him that Joule himself always pronounced his name 'Jole', with the first vowel as in 'Joe'.

I should be interested to know whether there is any corroboration of this third possible pronunciation.

A. W. V. MACE.

Rugby School Science Laboratory,
Barby Road, Rugby.

FURTHER to Prof. H. S. Allen's communication in NATURE of September 25, I may say that Joule used to live not far from my home at Sale, near Manchester, and I have often seen his house. His name was pronounced 'Joole', thus confirming Prof. G. W. O. Howe's pronunciation.

GRAHAM RENSHAW.

30 St. Ann Street,
Manchester, 2.

RESEARCH ITEMS

Shell Fish-hooks of the Californian Coast

THE Bernice P. Bishop Museum Papers for May 1942 include a useful account by Eugene Robinson of the types of shell fish-hooks in use on the Californian coast, and of the method of their manufacture. These hooks from the Santa Barbara Channel are of the circular type familiar in Polynesia and Micronesia, and are made by means of chert drills and stone files from pieces of shell cut to a flat pear-shape. Mr. Robinson explains how the circular hook, which looks so unpromising to a European fisherman, works in practice and is so satisfactory that steel hooks of similar pattern are sold in the stores of Honolulu. There must be no striking with these hooks; the fish hooks itself, and, with a gentle tension on the line, the hook turns over through the thin tissues at the edge of the fish's mouth, securing it more safely than an ordinary steel hook with a barb.

American Anchovies

SAMUEL F. HILDEBRAND gives a detailed review of the fishes of the family Engraulidæ in his paper "A Review of the American Anchovies" (Family Engraulidæ) (Bingham Ocean. Collect., Peabody Museum of Natural History, Yale University, *Bull.* 8, Art. 2, 1943). The anchovies are becoming increasingly important economically and, besides being fished commercially for food, are preyed upon by man, fishes and birds, and are also used extensively for bait. The review is very complete and contains descriptions of seventy-seven species and sub-species, nineteen of which are new. Keys are given to all the species in each genus and figures of most of them. They are carnivorous and typically pelagic shore fishes, usually moving about in schools, though sometimes taken singly at depths as great as 20–30 fathoms. Many ascend freshwater streams, especially in South America, where several species are found in the Amazon basin, a few of them in its upper tributaries. The author recognizes only one species apparently common to both Atlantic and Pacific coasts, *Anchoa spinifer*, and thinks it possible that even here specific differences may yet be found. The number of species from the Pacific recognized in these studies is only about two thirds as great as the number from the Atlantic, the chief home of the American Engraulidæ being in tropical and sub-tropical regions.

New Species of Fish

HENRY W. FOWLER describes a large number of new fishes from Florida, Eastern Brazil and Hawaii ("Notes on Florida Fishes, with Descriptions of Seven New Species. A Collection of Freshwater Fishes obtained in Eastern Brazil", by Rodolpho von Ihering. The George Vanderbilt Oahu Survey—The Fishes. *Proc. Acad. Nat. Sci. Philadelphia*, 93; 1941). The several collections noted in the first paper contain an interesting tide pool series from Florida made by Baldouin Lucke, showing early stages of development in certain species. The vernacular names are given in most cases in those from eastern Brazil making this paper of special value. In the third paper special attention is paid to colour, from notes made from the freshly received specimens, many of which remained brilliant for a long time. All these contributions are very well illustrated. Dr. Fowler has also published recently a series of short notices on fishes from 1939 until 1941 (Notulæ Naturæ of the Academy of Natural Sciences of Philadelphia).

Oysters of the Western Atlantic

RICHARD A. MCLEAN attempts to classify the family Ostreidæ (*Notulæ Naturæ*, No. 67; Jan 14, 1941. Academy of Natural Sciences of Philadelphia). T. C. Nelson (1938) has shown that the correlation between the depth of the valve and the position of the muscle scar is of great anatomical importance. In the forms with a relatively deep cavity in the valves and an accompanying posterior position of the adductor muscle there is a water chamber anterior to and running dorsal from the right epibranchial chamber—called by him the promyal chamber. It is open at the top and water is expelled through this channel to the outside in addition to the usual course. The possession of this chamber has a definite survival value, such oysters being able to live in more turbid waters than those without it: moreover, the type of reproduction is different in the two forms, those with the chamber being dioecious and oviparous whilst those without it are hermaphrodite and larviporous. The present author uses these facts for separating two sub-genera of the genus Ostrea when the anatomy and type of reproduction are known. There is only one genus in the family with the sub-genera Ostrea s.s., without promyal chamber, and monoecious, incubating the large embryos in the gill lamellæ, and Crassostrea, the type being *Ostrea virginica*, with promyal chamber, and dioecious, discharging the seminal products directly into the water.

Longevity of Paramecium

L. L. WOODRUFF (*Proc. U.S. Nat. Acad. Sci.*, 29, 135; 1943) reports that about 21,800 generations have taken place in a culture of *Paramecium aurelia* since it was started in 1907. No conjugation has been observed, and it would, therefore, seem that the vitality of these unicellular organisms is preserved without conjugation. The possibility of endomixis, of course, must be considered; nevertheless, the fact that the rate of division and general vitality of the culture has remained constant without cross-fertilization is notable.

Polyploidy and X-ray Dosage

K. Frôier, A. Gustafsson and O. Tedin (*Hereditas*, 29, 145; 1943) show statistically that on wheat and oats the effect of X-rays upon mitosis in dormant seeds differs significantly between diploids, tetraploids and hexaploids. Hexaploids possibly provide a straight-line curve of X-ray dosage, whereas diploids and tetraploids show a sigmoid curve. The authors suggest that it would be wise to re-investigate straight-line proportionality especially at low dosages of X-ray.

Soil Conditions in the Plant Pot

THE greater volume of work on soils has been carried out on open ground, and relatively little is known, apart from culture experiments, about the limiting conditions of growth in a plant pot. Two papers by A. G. Pollard and C. W. R. Smith (*J. Roy. Hort. Soc.*, 68, Pts. 7 and 8; July and August 1943) describe some preliminary experiments upon the special conditions in such small units of soil. Levels of the major soil nutrients are higher in the field than in pots, and are higher in pots indoors than

when placed in the open. Glasshouse conditions, moreover, produce the greatest ratio of shoot to root. Part of the disappearance of soluble matter from soil in pots is probably due to the action of the earthenware wall, and lime is removed in greater proportion than phosphate and potash. The papers are very suggestive, and some extremely useful results should accrue from a continuance of the investigation.

Granitization of Hornfelsed Sediments

A DETAILED field, petrological and geochemical study of the hornfelsed Silurian sediments enclosed within the Newry granodiorites of Goraghwood Quarry, Co. Armagh, has been made by Doris L. Reynolds (*Proc. Roy. Irish Acad.*, **48**, B, No. 11, 231–265; 1943). It is established that two major changes are involved in the granitization process. The preliminary change was the metasomatic development of irregular bodies, lenticles, veins, etc., of porphyritic trondhjemite from two varieties of biotite-hornfels; a change involving the fixation of migratory Na_2O, CaO and SiO_2, with concomitant driving out of other constituents. Migratory MgO and FeO, together with an appropriate amount of K_2O, can be traced in the rims of biotite and cordierite enrichment which are characteristically developed around the granitized bodies. The second major change was the development of porphyroblasts of microcline, and of bodies of granodiorite, adamellite and granite-pegmatite, both from earlier-formed masses of trondhjemite and directly from biotite-hornfels. This change involved the fixation of K_2O, an immediate source for which is found in the migratory K_2O liberated from the hornfelses during the preliminary soda metasomatism. A third variety of metasomatism is the conversion of diopside-hornfels to biotite-hornblende-plagioclase hornfels, which is chemically and mineralogically equivalent to quartz-biotite-diorite. The chemical data indicate that the minimum introductions necessary to initiate the complex geochemical migrations were sodium, calcium and silicon, and that all the other constituents can be adequately accounted for as derivatives from the hornfelses themselves. At the completion of the granitization process at one place the unfixed balance of sodium, calcium and silicon travelled on, to recommence the granitization cycle at fresh loci. Repetition of the process continued until the supply was exhausted. It is concluded that the introduced materials were passing through and/or emanating from the granodiorites at the time of their crystallization. The problem of their ultimate source lies outside the scope of the investigation and remains to be tackled by further work elsewhere.

Polymerization of Hydrogen and Deuterium Fluorides

THE vapour densities of these compounds over a range of temperatures and pressures have been redetermined by R. W. Long, J. H. Hildebrand and W. E. Morrell (*J. Amer. Chem. Soc.*, **65**, 182; 1943). The highest degree of association found was 4·5, the association factors for deuterium fluoride being appreciably higher at each temperature than those of hydrogen fluoride. A previous proposal by J. H. Simons and J. H. Hildebrand (*J. Amer. Chem. Soc.*, **46**, 2138; 1943), although it has not been substantiated by subsequent work, is again considered in relation to the experimental results: it assumes that only hexamers are present in the polymerized product, $6HF = (HF)_6$, and is found to represent the results fairly well, although there is indication of lower polymers at lower degrees of association. This agreement is not regarded as amounting to proof of its sufficiency.

An Analysis of British Meteor Data

J. G. PORTER has published a paper with the above title which reveals the unsatisfactory nature of some of the old methods for computing the real paths of meteors (*Mon. Not. Roy. Astro. Soc.*, **103**, 3; 1943). In many cases, more especially in Denning's lists, preconceived opinions were formed regarding the position of the radiant, and the paths recorded by the observers were adjusted to fit in with this. The result was that systematic and accidental errors made by observers were obscured by the non-systematic errors allowed by the computer of the real paths. The value of such a procedure became more obvious when paths were recorded by more than two observers; in many such cases very drastic adjustments were necessary, and in addition, in many of the doubly observed meteors it is shown that real paths and radiants were computed when there were no accordances at all. It was realized many years ago by the Meteor Section of the British Astronomical Association that the old method, which was still in use, was most unsatisfactory, but it was not until 1936 that an entirely new method was developed by Davidson, and the Computing Section of the British Astronomical Association immediately undertook the reductions under the directions of Porter. It is interesting to notice that of 232 paths published by Denning, where original data were available, it was necessary to reject 60 as being of zero weight, and in 172 of the remainder serious discrepancies between heights, lengths of paths, and speeds, exist when Denning's results are compared with those of Porter. Altogether 1,253 reductions have been made by the new method and results have been published from time to time (*J. Brit. Astro. Assoc.*). In the present paper Table 1 gives multiple accordances from 1892 to 1940, a total of 61, and Table 4 supplies results for the old accordances from 1865 to 1928. A very full discussion of errors is embodied in the paper, and it is shown how Prentice's technique for observation has introduced a considerable improvement in the results. It is hoped that further research will settle finally the vexed question regarding hyperbolic meteors, which British observers are very reluctant to accept.

Cleaning of Mirrors before Aluminizing

A paper with this title by Vladimir Vand (*J. Brit. Astro. Assoc.*, **53**, 7; 1943) provides an interesting account of the troubles encountered in the new process of aluminizing mirrors. These are divided into four chief classes: (1) Imperfect cleaning of the mirror. It has been found that a layer of impurities, even if only one molecule thick, between the glass and the coating, affects the coating very seriously. (2) Imperfect vacuum which is sometimes responsible for brown or black deposits. (3) Dirty aluminium and/or tungsten spirals which are responsible for impurities being evaporated on the mirror, and then aluminium is deposited on top of these. (4) The deposit is too thick, and when this occurs a milky deposit sometimes results. The paper deals very fully with these difficulties and with the methods adopted for overcoming them, and those who have had their mirrors aluminized will appreciate, from a perusal of this paper, the enormous amount of care and attention which are necessary if satisfactory results are to be obtained.

THE PLANE TREE

By ALEXANDER L. HOWARD

TRAVELLERS from warm and sunny countries criticize, quite rightly, the smoky atmosphere of London. It is a curious but fortunate fact that this damp and smoky climate, which retards the growth of nearly all forest trees, for some unknown reason invigorates the plane (*Platanus orientalis* Linn., *P. occidentalis*, *P. acerifolia* Willd.).

Throughout the City and its suburbs this lovely tree flourishes in all its grandeur and beauty, and completely outclasses other varieties introduced from foreign lands. For example, the acacia cannot live in England up to its national reputation in America, and has utterly failed to fulfil Cobbett's well-known claims.

It would probably be impossible to find a more beautiful avenue of trees than that which leads up the Mall to Buckingham Palace. These trees are now in their youth, and should grow in dignity for at least another two centuries, but already their spreading beauty in summer and their equally imposing winter aspect are unique. Planted and spaced at regular intervals, without failure or exception they have grown to a uniformity in size, both as regards the crown and the trunk. No other tree but the plane could be relied upon for such regularity of growth, and it is partly for this reason that it is so suitable for avenue and roadside planting.[1]

Whilst all Londoners are familiar with its grace and beauty, and grateful for its cool shade in dusty summer heat, it is doubtful whether many realize the history of this interesting foreigner, which has become so happily naturalized in Great Britain. Indeed, such is our national ignorance and lack of education on this important subject, that only a small minority of English people know the difference between a plane and any other forest tree, despite its annual habit of shedding its bark, which is its own original and destructive way of keeping healthy.

Its tenacity and stubborn resistance to violent attack has been exemplified. "A fine plane tree can now be seen flourishing by the side of the Grand Junction Canal in London, close to the North Gate of Regent's Park leading to Avenue Road. It has an interesting history. In 1874 a barge containing petroleum, while passing up the canal, exploded with a report which was heard ten miles away. The bridge and the keeper's cottage were blown away, the plane tree being apparently destroyed. Thirty years after, the only part of the old trunk remaining was a dead, charred, pointed piece, which could be seen protruding through the new and vigorous growth around it; this dead piece has now disappeared (1932), and the only sign of the disaster which remains is an opening extending from the ground to about 10 feet from the present top of the tree. This opening is now closing, and it is safe to predict that in a very few years the trunk will no longer bear any evidence of the damage". This opening is now (1943) scarcely noticeable.

The Times has quoted another instance of what the contributor called "The Dauntless Tree", namely, the plane tree outside Stationers' Hall, which, "in spite of fire and bombs which stripped it of all its leaves and branches, put forth new leaf all up its abnormally straight stem, symbolising the dauntless spirit of London".

An admirable picture was produced in the *Tree Lover*, entitled "Bath after the Blitz", showing five plane trees in the demolished Circus; it now transpires that these trees are much less damaged than was originally thought to be the case.

From earliest times history records examples of the prominent position held in arboriculture by the plane tree, which was introduced first into Greece, and afterwards into Italy, and afterwards throughout all Europe, southern Asia, and in Persia, where the magnificent 'Chenar' trees have been the pride of its people. Continual reference is made to the plane tree before and after the rise of the Roman Empire. About the year A.D. 530 Pliny tells us:

"But who would not marvel rather at this, that our people here should go into farre countries, and fetch a tree from thence, even out of another world, only for the shade that it giveth. For surely of fruitful trees Italie hath store ynouth. And what tree should that be but the very plane, brought first over the Ionian Sea into the island Djomedea, for to beautifie the tomb of Diomides. From thence translated into Sicilie and so bestowed at length upon Italie, and there planted, as a most regular, rare, and special tree. But now it is caried as far as Tetwin and Tournay in France, where it is counted an appertenance to the very soile that paieth tribute, insomuch, as people will but walke and refresh themselves under the shadow of it, must pay a custom therefore unto the people of Rome. Dionysius, King of Sicile, and the first of that name, caused them to be brought from Rheguim in Calabria to his roiall cittie, where his palace was, onely of a singularitie because they should be seen to give a shade before his house, where afterwards was made the Colledge or a place of public exercise."

and:

"Of a certaine region we have before written, called Aulocrene, lying in the way between Apamia and Phrygia: and there the paisants of that countrey can show you that very plane tree, on which Marsyas the musician hung himselfe in a melancholly mood, for that he was overmatched in his owne cunning and professed skill, by Apollo: And surely like it is, that even then he made choice of that tree for the bignesse."

Evelyn says:

"This beautiful and precious tree, originally sacred to Helena . . . was so doated on by Xerxes that Aelian"

and other authors tell us:

"He made halt and stopped his prodigious army of seventeen hundred thousand soldiers, which even covered the sea, exhausted rivers, and thrust Mount Athos from the Continent, to admire the pulchritude and procerity of one of them; and become so fond of it, that, spoiling both himself, his concubines, and great persons of all their jewels, he covered it with gold, gems, necklaces, scarfs, and bracelets, and infinite riches; in sum, was so enamoured of it, that for some days neither the concernment of his grand expedition, nor interest of honour, nor the necessary motion of his portentious army, could persuade him from it."

Elwes and Henry in "Trees of Great Britain and Ireland" tell us that *Platanus orientalis* was introduced into England some time before 1562; the Western plane *P. occidentalis* in 1636; and distinction was made of the botanical species *P. acerifolia* in 1703. They also enumerate a great number of outstanding examples, including one "planted by Bishop Gunning in the Palace Gardens at Ely in 1896. It was found by the shadow to be about 100 feet high and 23 feet in girth at 3 feet from the ground". At Mottisfont Abbey there is a magnificent tree which Elwes measured in 1898, 29 ft. 8 in. at 4½ ft. from

the ground. This tree is remarkable on account of its gnarled growth. He also mentions one at Woolbending Rectory, Sussex, about 105 ft. high by no less than 25 ft. in girth, and directs attention to the triumphant beauty of the avenue at Cowdray Park. They also say:

"The planes in Berkeley Square are worth notice on account of their uniform burry trunks swelling at the base. . . . They were planted by Mr. Edward Bouverie in 1789 and are probably the oldest plane trees in London. According to Mr. Birkbeck the two largest, in 1906, girthed at 5 feet, 13 feet 10 inches and 13 feet 4 inches respectively, and were about 85 feet high. (The largest of these now measures 14 feet 9 inches in girth and 5 feet 1 inch in diameter at base.)

Tradition says that this was a burial ground during the Plague of London in 1665."

Although these trees grow to a magnificent size in England they do not compare with those of which Pliny writes as follows:

"and in truth this tree [the plane tree], and the situation thereof, is so admirable, that Licinius Mutianus, thrice Consul and late Lieutenant Generall and Governour of that Province, thought this thing worthie to be regarded as a memoriall to posteritie, when he and 18 *mors persons* of his Companie used to dine and sup within the hollownesse of that tree; where the very leaves yeelded of the own sufficient bed and bench room to rest and repose themselves."

Record trees are also quoted in Greece, Constantinople, and Samarkand, where the immense girths of 37 ft. and 39 ft. were attained.

Earl Sandwich in the year 1739 directed attention to

"the great Plane of the island Stanchio (anciently Cos). . . . is remarkable for its size and the care with which the natives have attempted to preserve it. It has stood for time immemorial in the chief town of the island, and while it is the boast of the inhabitants, it is also, and with justice, the wonder of strangers."

He also remarked

"Among the curiosities of this city is a Sycamore-tree, which is, without doubt, the largest in the known world . . . from the outside verge of which, to the trunk, I measured forty-five large paces."

It is supposed that early botanists mistook the *Acer pseudoplatanus* for the fig-tree, or gave it this name on account of its resemblance. It seems more likely, however, that the tree they saw was the plane tree. That which we call sycamore the Americans more correctly term the great maple. In bark and timber, in flower and seed, there is no resemblance whatever between the *Acer pseudoplatanus* and the *P. orientalis*. According to Sargent, Acer is the classic name of the maple tree, and Platanus is the name of the plane tree. In America all the timber of the Acer species is called maple, and that of the Platanus sycamore. In Scotland the produce of *Acer pseudoplatanus* is called plane. The resulting confusion can easily be understood.

Throughout France and Germany the value of the timber produced by the plane tree has always been recognized. Not only were the trunks of the trees utilized with the utmost economy, but even the limbs have been carefully converted and put to useful purpose for furniture, floorings, and interior decoration. In America, also, its value has been fully realized, and the wood has been quarter sawn, which displays handsome marking, and earned the name of 'lace-wood', by which it is well known to American craftsmen and in their export trade. It is only in England that the wood has been entirely wasted except as fuel.

The original oak panelling, comprising hall, staircase, and doors in a country mansion damaged in the course of the War of 1914–18 was replaced by American 'lace-wood', but while all who saw the woodwork admired it, not even the owner knew its name or origin.

Magnificent fully grown specimens of this particularly graceful tree can be found in abundance scattered throughout England, Scotland, and Wales, and roadside planting has been steadily carried out in all our towns and villages. In other directions, however, unfortunately, for more than a hundred years big-scale planting has been neglected.

SCIENCE AND THE WAR EFFORT

THE meetings on "Science and Victory" arranged by the Association of Scientific Workers in London on July 11, which took place simultaneously with one in Moscow, well emphasize the critical importance of science in the war effort of both nations and the determination of scientific workers to see that the fullest possible use is made of the scientific resources available. Copies of the addresses given have been made available by the Association.

Sir Robert Watson-Watt in his chairman's address put the essential point squarely enough: no military operation to-day can be a sustained success without applied science. Important and essential as are the other factors, without science they are not enough. Moreover, as other speakers pointed out, it is not merely the part of science in production, in the manufacture of munitions of all kinds and in the development of new weapons and of instruments of ever greater precision that is vital: a new scientific function—that of operational research—has emerged in Britain and in the United States, and in Soviet Russia appears to have existed before the outbreak of war.

Prof. J. D. Bernal's picture of these developments is highly suggestive. Operational research is no longer limited to the technical performance of weapons in the field under the supervision of those competent to assess performance and suggest effective improvements. Strategy as well as tactics has come under scientific surveillance on the field of battle itself. The processes of warfare itself, the effectiveness of various forms of attack and defence are being studied by specially trained men of science, and the results are being analysed and translated into improved tactical methods and weapons. In all this, Soviet Russia appears to have been a pioneer, though both countries are now using men of science for similar extended functions.

In Great Britain, at the present time, as Prof. Bernal suggests, the novelty of the military and operational use of scientific workers is attracting more attention and overshadowing some of the equally important achievements of science, no less vital to our war effort; in the fields of agriculture, nutrition and food supply, and health, it has provided substitutes for essential commodities of which we have been deprived or restricted by the War, especially in the Far East. The post-war consequences of these developments may well be highly important. It was natural for a meeting of scientific workers to

look to establishing closer and more direct contact with Soviet scientific workers engaged with us in a common struggle, as has been done already with the United States, and to hope for similar collaboration in building up a new world in which science will at least be free to devote itself wholeheartedly to the service of humanity. Scientific liaison with the U.S.S.R. may well be an important aid to mutual understanding between the two nations, for if we have much to learn of the Soviet effort it is at least equally true that they have much to learn of Britain.

Prof. Bernal's review of these developments suggests, however, that an even more important post-war consequence may be a much greater general awareness of the importance of science: not merely an appreciation of its achievements but a greater desire to understand its method and possibilities. Mr. J. G. Crowther touched on this educational aspect, more particularly in respect of the opportunities in the munitions industry, in an address which referred to some points made at the British Association Conference last March on "Science and the Citizen" with regard to ways and means of increasing the public understanding and appreciation of science. None the less, the significance of the educational opportunities which the increased operational contacts with science in the Forces and the greater use of scientific instruments and weapons by fighting men themselves offer in respect of the post-war world, scarcely appears to be appreciated. If that opportunity is seized, if every possible means is used, whether now through such means as the Army Education Corps or through the Workers Educational Association and other instruments of adult education after the War, to bring home to the ordinary citizen not merely the achievements but also the nature of science and the limitations as well as the possibilities of the scientific method, we shall have taken a long step towards making it possible for society to enjoy the abundance which science has put within our power.

That achievement depends on the use of science, and our scientific resources for science—like planning—has its dangers and limitations, and Britain and Soviet Russia have much to learn from their widely different experiences. We cannot make full and wise use of science in a democracy without a widespread understanding of what science is, what it can do and what it cannot do, and in this respect it may well be that Britain lags somewhat behind Soviet Russia. What may fairly be open to doubt is, as Prof. Polanyi showed in a recent paper, whether Soviet Russia has always understood the true nature and limitation of the scientific method. Science and politics may be consorts but they are ill-mixers, and science and propaganda go ill together. Quality, not quantity, is the vital element in science.

The eloquent plea for co-operation and mutual understanding between science and government, statesmen and men of science, which was uttered by Mr. J. G. Crowther at the meeting emphasizes a further point which lies behind the effort of Soviet and British scientific workers in the struggle with Germany. Whatever the imperfections or neglect of science in Britain and in Russia, both countries are to-day struggling against a power which has struck at the well-springs of scientific thought and advance. As a cable from the Moscow meeting addressed to the Association stated, the Nazis have set themselves deliberately to extinguish the torch of knowledge. Their regime threatens the very existence of scientific life and thought, and while that threat remains there can be no security for the free spirit of inquiry, the patient, independent investigation and creative thought which are the essence of science and the secret of its advance. That challenge has been taken up wholeheartedly by British and by Soviet scientific workers, and the meetings in Moscow and in London on July 11 attest their sincerity and determination. Scientific workers, in addressing themselves to their wider tasks and in accepting wholeheartedly their social responsibilities, must remember also that it is their prime responsibility to guard and cherish that unfaltering quest for truth which is at the heart of science, and to make sure that in all their organization and planning they consent to nothing that impairs their freedom of inquiry or utterance and the ultimate but fundamental loyalty to truth.

CLINICAL PHOTOGRAPHY

AT a meeting of the Association for Scientific Photography held on September 18 at Middlesex Hospital, Dr. H. Mandiwall stressed the particular qualities required in clinical photography. In his opinion these are: (*a*) a simple straightforward record with perfect definition; (*b*) a self-explanatory picture, but nevertheless one which does not include unessential portions; (*c*) a well-presented print, as much care being taken in the mounting and finishing as in a studio portrait; (*d*) in the case of colour photographs, the colour must be true to the original. This is of particular importance in skin diseases which are characterized by the colours of the part affected. It was suggested that a Clinical Group should be formed in the Association, which would discuss the special aspects of this work, and compare technique.

Another point was the collaboration between photographers and manufacturers of apparatus. The requirements of clinical photography are in many cases distinct from those of studio or outdoor work, and it would be of great advantage to have certain apparatus specifically designed for the work.

In opening the meeting, Mr. T. Pomfret Kilner stressed the importance of standardization in technique, particularly in his own sphere of plastic surgery. The photographs taken before and after treatment must be strictly comparable as regards type of film, exposure, lighting, etc. He illustrated his remarks with views of a simple equipment employing a Leica camera and photoflood lighting which enables photographs to be taken at any angle and can also be used for copying radiographs or documents. He recommended that Ortho materials be used for the majority of work; previous to the War, he had always used Agfa Isochrom film.

Miss Hilda Marsden showed examples of the work done in clinical photography at the Christie Hospital, Manchester, using a half-plate camera with studio technique. She laid special stress on the importance of lighting, particularly in delineating the outlines of growths, etc.

In the discussion which followed the papers, Mr. J. E. Andrews showed illustrations of a convenient set-up for photographing patients in bed which was made with the aid of a pair of steps such as is always available in a hospital. The camera was fitted to the top of the steps with the usual ball-and-socket joint and could be directed in any required position. By means of interchangeable lenses and lights also fitted to the top of the steps at varying angles, he was

able to take a variety of photographs of a patient from head only to full-length. He had found that a 4¾-in. lens was adequate for full-length and an 8-in. for head and shoulders. A 14-in. lens gives a close-up of an individual part with the patient lying flat about 5 ft. below the camera.

As a matter of interest, Mr. Andrews showed a photograph of a patient with one brown eye and one blue, taken with orthochromatic film without a filter. Only one photoflood lamp was used, and the colour rendering was excellent.

Mr. K. Hennell (Metal Box Co.) said that he had taken several thousand clinical photographs during the War in colour, and used Sashalite bulbs exclusively for illumination. He considered this was the best method for tackling a variety of jobs and agreed with Mr. Kilner concerning the necessity for standardization. He exhibited several samples of colour prints on paper.

It was in the discussion generally agreed that clinical photography should be undertaken by a professional photographer who would find it advantageous to make a special study of physiology and anatomy. It was not considered reasonable to expect a medical man or surgeon to do his own routine photography, and it was also pointed out that the majority of hospitals, while equipped for X-ray work, are not well equipped for clinical photography.

Those interested in the formation of a Clinical Photography Section should write to the secretary of the Association, Mr. R. M. Weston, at Houndwood, Farley, Nr. Salisbury, Wilts.

REHABILITATION OF THE 'SCORCHED EARTH' IN THE U.S.S.R.

THE preliminary arrangements have recently been announced by the Soviet Government for the rehabilitation of the different regions of the U.S.S.R. as they are liberated from the Germans. A Commission has been set up representing forestry, timber supply and other interests to arrange for the erection of buildings on the collective farms and of dwellings for the workers. Use is to be made of local supplies of brick or artificial stone of various kinds, and of houses prefabricated in factories: the standard is to be a flat for four families, and thirteen factories are to be put into operation with a capacity of eighty flats per month. The Agricultural Bank will allow 10,000 roubles credit to each family for a period of seven years.

Railways also are to be restored, and dwellings for the staff and the various establishment shops and buildings are to be erected.

Such live-stock as were driven eastwards are to be restored, and regulations have been drawn up for the movement of specified numbers of the animals from seventeen of the reception areas to collective farms in specified regions including Orel, Smolensk, Voronezh, Stalingrad, Rostov, and Stavropol: impressive totals are involved, including 206,000 cattle, 342,000 sheep and goats and 53,000 horses, though these represent only a fraction of the peace-time numbers of animals in these regions. Collection of the animals at specified points in the reception areas was to be completed by September 1, and they were to reach their destination between October 1 and 15. The difficulties will be considerable, but the routes have been worked out: the journey for the animals is in some cases 800 miles. Arrangements have been made for feeding and watering the animals during their journey and for checking the numbers and duly accounting for their arrival. The risk of carrying disease will be very great, but fifty veterinary surgeons (1 for each 12,000 animals) and a hundred assistants are to be seconded from the reserve of the Red Army and distributed along the routes. In order to ensure further attention when the animals reach their destination, schools are to be set up in each liberated province giving veterinary courses varying in duration from three to twelve months. The Agricultural Publishing House is to be given 50 tons of paper for the printing of instructional literature. Other decrees deal with the provision, payment and transport of the drovers.

Collective farms are being recommended to keep all male calves of 1942 and 1943 to become working oxen.

In the case of poultry, it was necessary to establish incubator and poultry-breeding stations sufficient to deal with 16 million eggs: the aircraft industry was instructed to supply the thermostats and thermometers. The number of specialists required will be considerable: 130 are to be detailed for the new stations, but this number will not suffice, and it is proposed to start courses for training a further 580. In order to ease the work of the collective farms as they are re-established, considerable exemptions during the first year are permitted from the deliveries required to be made by the farm to the State; these apply to farms that have suffered from enemy occupation and households that have suffered bereavement or in which the able-bodied members belong to a specified group of experts. Tractor maintenance and repair stations are to be set up, and schedules are issued of spare parts, etc., that must be stocked.

Special provision is made for supplying railway workers with allotments of about one-third acre on which they may grow what crops they like. These plots are to be exempt from compulsory deliveries to the State: they are to be supplied with seeds, pigs and chickens. Provision is also to be made for the education of orphans and children of Red Army men and partisans; there are to be nine 'Suvorov' military schools, somewhat like the old cadet schools, each for about five hundred boys; and twelve 'industrial' schools for boys from the age of ten and for girls from the age of eleven. Co-education is not adopted in these new schools. Houses for 16,300 children are to be set up.

LIGHTNING PROTECTION OF BURIED CABLE

FOR the new toll facilities now being installed in the United States, much of the cable is laid underground to secure greater immunity from effects of sleet, snow, and storms. Burying the cable alone is not necessarily sufficient to free it from the effects of lightning damage. Moreover, when lightning damage such as fusing of cable pairs or holes in the sheath does occur, it is not so easy to locate and repair as on aerial cables since excavations may have to be made at a number of points. As a result of this situation, studies have been made of the factors affecting damage of buried cables by lightning, and

the remedial measures which have been devised to provide substantial protection in most cases that are encountered are described in an article by E. D. Sunde (*Bell Lab. Rec.*, **21**, No. 9; May 1943).

When lightning strikes, the current spreads in all directions from the point where it enters the earth, and if a cable is in the vicinity it will provide a low-resistance path so that much of the current will flow to the cable and in both directions along its sheath to remote points. The flow of current in the earth between the lightning channel and the cable may give rise to such a large voltage drop that the breakdown voltage of the soil is exceeded, particularly when the earth resistivity is high. The lightning stroke will then arc directly to the cable from the point where it enters the earth, often at the base of a tree. When this happens practically all the current reaches the cable sheath. Furrows so long as 100 ft. have been found in the earth along the path of such arcs.

The current entering the sheath near the stroke point is attenuated as it flows toward remote points. The current leaving the sheath must flow through the adjacent soil, and the amount of this leakage current per unit length of cable is therefore smaller if the soil resistivity is high than if it is low; thus the current will travel farther the larger the earth resistivity. The flow of current along the sheath produces a voltage between the sheath and the core conductors, which is largest at the stroke point. This voltage is substantially equal to the resistance drop in the sheath between the stroke point and a point which is sufficiently remote so that the sheath current is negligible. Since the higher the earth resistivity, the farther will the current travel, this resistance drop will also increase with the earth resistivity. The maximum voltage between sheath and core is thus proportional to the sheath resistance and also to the square root of the earth resistivity. Carrier cables now being used are of smaller size and have a higher sheath resistance than full-size voice-frequency cables, and for this reason they are more subject to lightning damage, particularly when the earth resistivity is high.

Tests were made on the Stevens Point-Minneapolis cable, using a surge generator which generates a short-time surge of current similar to that of a lightning discharge but of much smaller magnitude. An earth was established remote from the cable, and the surge generator was connected between this earth and the cable sheath, and between the remote earth and earths at distances of 10, 25, and 100 ft. from the cable. Results of the tests are given in the article.

When the voltage at the point where current enters the sheath is great enough to break down the insulation, the conductors and sheath are brought to essentially the same potential by the arcing. Under these conditions, the voltage between conductors and sheath increases with distance along the cable. A maximum is reached at some distance from the original fault, and beyond this point the voltage slowly decreases. After a puncture of the insulation where the current enters the sheath, other failures may therefore occur at some distance from this point in either or both directions. A single lightning stroke may thus cause insulation failures over a considerable distance along the cable.

One method of reducing failures caused by lightning strokes to buried cables is to increase the core insulation. This has been done for most new installations of buried cable. The cable itself, and such accessories as cable terminals and stubs, loading pots, and gas-alarm contactors are all provided with sufficient extra insulation to double the dielectric strength between cable conductors and sheath. For a cable like the one on which measurements were made, such increased insulation would reduce the number of lightning strokes that could cause failure by direct arcing to the sheath to about 15 per cent of the total instead of 50 per cent, and would almost entirely eliminate the danger of breakdown when lightning strikes the earth as much as one hundred feet from the cable. Another method, which may be employed in addition to the extra insulation where excessive lightning damage would otherwise be expected, is to bury shield wires over the cable. These conduct away part of the lightning current and thus reduce the amount that flows along the sheath. These wires may be ploughed in with the cable, or they may be installed afterward. The percentage of the current carried by the wires depends to a greater extent on their inductance relative to that of the sheath than on their resistance. Two wires are employed in order to obtain a lower inductance than would be possible with a single wire.

On the route between Stevens Point and Minneapolis where the shield wires were installed after the cable was in place, two 165-mil copper wires about 12 in. apart were ploughed in some 10 in. above the cable for a distance of 80 miles. Surge measurements made after these wires were installed indicated that the wires reduced the voltage between sheath and core conductors by about 60 per cent, which is in substantial agreement with theoretical expectations. The shield wires should thus reduce the number of direct lightning strokes that would be expected to cause failure to about 10 per cent, instead of 50 per cent without shield wires.

PLANT DISEASES

SEVERAL papers concerning plant diseases appear in a recent number of the *Transactions of the British Mycological Society* (**26**, Pts. 1 and 2; April 1943). Measurement of the intensity of plant disease in the field has occupied the attention of a sub-committee of the Society's plant pathology committee. The results indicate some rather suggestive lines of attack in the investigation of several diseases. A graph showing the incidence of potato blight at the Seale Hayne Agricultural College for different years, and for other localities for 1941, is very illuminating. The quick rise to a high degree of infection in 1932 is in marked contrast to the slow development of the disease in 1937, and merits further investigation. Other results are quite as suggestive. The sub-committee's main contribution, however, is in the standardization of methods, details of which are given in the paper.

W. C. Moore continues his series of descriptions of new and interesting plant pathogens. A disease of maize seedlings raised in nutrient solution was found to be caused by *Fusarium moniliforme*. It could be eliminated from the grain by soaking and heating to 54° C. for 20 min. A species of Penicillium, probably *P. hirsutum*, has also been assigned as the cause of a rot of Scilla bulbs, and *Helminthosporium Allii* is the pathogen of a bulb canker of garlic. This disease was discovered in an imported consignment before it could be planted, and so should not establish itself here. A brief note by H. Duerden announces

the appearance of *Pythium mamillatum* in England. It produces a damping-off disease of cress, similar to that caused by *P. deBaryanum*. Elizabeth Blackwell gives details of the very complex life-history of *Phytophthora cactorum*, a species with pathogenicity upon such widely differing genera as Cereus, Acer, Pyrus, Pæonia, Rheum, Fagus, Pinus and others. The species is paragynous and homothallic, and considerable progress in control of this parasite should result from this careful analysis of the many stages of its life-cycle.

In the realm of bacterial plant pathogens, W. J. Dowson publishes a list of species, with synonyms, which should be included in the genera Pseudomonas, Xanthomonas and Bacterium. This should be useful as it is difficult for the general pathologist to follow all the changes in modern bacterial nomenclature.

FORTHCOMING EVENTS

Saturday, October 9

SHEFFIELD METALLURGICAL ASSOCIATION (joint meeting with the MICROCHEMICAL SECTION OF THE SOCIETY OF PUBLIC ANALYSTS and the SOUTH YORKSHIRE SECTION OF THE ROYAL INSTITUTE OF CHEMISTRY) (in the Department of Applied Science, The University, St. George's Square, Sheffield), at 2.30 p.m.—Symposium on "Microchemical Analysis".

Tuesday, October 12

SOCIETY OF CHEMICAL INDUSTRY (CHEMICAL ENGINEERING GROUP AND LONDON SECTION) and the INSTITUTION OF CHEMICAL ENGINEERS (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 2.30 p.m.—The Rt. Hon. Lord McGowan: "The Future of the Chemical Industry".

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1), at 5 p.m.—Dr. W. Norwood East: "The State, the Criminal and the Psychiatrist".

CHEMICAL SOCIETY (LEEDS AREA LOCAL SECTION) (in the Chemistry Lecture Theatre, The University, Leeds), at 6.30 p.m.—Dr. E. H. Farmer: "Autoxidation in Relation to Olefinic Structure".

Thursday, October 14

INSTITUTE OF FUEL (at the Connaught Rooms, Great Queen Street, London, W.C.2), at 2.30 p.m.—Dr. E. S. Grumell: Melchett Lecture.

Friday, October 15

PHYSICAL SOCIETY (at the Royal Institution, Albemarle Street, Piccadilly, London, W.1), at 4.30 p.m.—The Rt. Hon. Lord Rayleigh, F.R.S.: "Optical Topics, in part connected with Charles Parsons" (Eighth Parsons Memorial Lecture).

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1), at 4.45 p.m.—Dr. N. S. Finzi: "Impending New Developments in Radiotherapy".

Saturday, October 16

INSTITUTE OF PHYSICS (X-RAY ANALYSIS GROUP) (joint meeting with the MANCHESTER AND DISTRICT BRANCH) (in the Physics Department, The University, Oxford Road, Manchester), at 2.30 p.m.—Sir Lawrence Bragg, F.R.S.: "The Physical Optics of X-Ray Analysis"; Short Papers and Exhibition of Apparatus, etc., relating to Industrial Problems.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

TEACHER OF CHEMISTRY for Junior Work in Technical Day School and Industrial and Intermediate B.Sc. Classes in the Technical College, a TEACHER OF MATHEMATICS for Junior Work in Technical Day School and Technical and Intermediate B.Sc. Mathematics in the Technical College, and a TEACHER OF MECHANICAL ENGINEERING SUBJECTS up to Higher National Certificate standards, in the West Hartlepool Technical College—The Chief Education Officer, Education Offices, Park Road, West Hartlepool (October 14).

TEACHER OF MATHEMATICS AND PHYSICS in the Junior Technical School and Senior Part-time Classes in the Batley Technical College—The Director of Education, Education Offices, Batley, Yorks. (October 15).

ADVISORY OFFICER IN PLANT PATHOLOGY—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (October 15).

DIRECTOR OF ROBERT GORDON'S TECHNICAL COLLEGE—The Secretary, Robert Gordon's Technical College, Aberdeen (October 16).

BOROUGH ELECTRICAL ENGINEER—The Town Clerk, Council Offices, Kettering (October 22).

PROFESSOR OF ENGINEERING—The Registrar, University College, Singleton Park, Swansea (November 20).

LECTURER IN EDUCATIONAL PSYCHOLOGY AND TEACHING METHOD—The Principal, Gipsy Hill Training College for Teachers of Young Children, at Bankfield, Bingley, Yorks.

TECHNICAL ASSISTANT in a Government Department in London for work connected with the planning of production of X-Ray Equipment—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Section D.502, Alexandra House, Kingsway, London, W.C.2.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Medical Research Council: Industrial Health Research Board. Emergency Report No. 4: A Study of Absenteeism among Women. By Dr. S. Wyatt, R. Marriott and D. E. R. Hughes. Pp. 12. (London: H.M. Stationery Office.) 2d. net. [118

Industrial Research: What it Means to British Industry. By Sir Harold Hartley. Pp. 16. (London: Federation of British Industries.) [129

City and Guilds of London Institute. Report of the Council to the Members of the Institute for the Year 1942. Pp. lviii. (London: Gresham College.) [139

Proceedings of the Royal Irish Academy. Vol. 49, Section B, No. 9: Salmon of the River Shannon. By Arthur E. J. Went. Pp. 151–176. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 1s. 6d. [139

Annual Reports on the Progress of Chemistry for 1942. Vol. 39. Pp. xxviii+257. (London: Chemical Society.) 15s. [169

Henley Student Manual. Pp. 28. (London: W. T. Henley's Telegraph Works Co., Ltd.) [189

British Association for the Advancement of Science: Committee on Post-War University Education. Report on University Entrance Scholarships in England and Wales. Pp. 8. (London: British Association.) 6d. [199

Board of Education. The Youth Service After the War: a Report of the Youth Advisory Council appointed by the President of the Board of Education in 1942 to advise him in questions relating to the Youth Service in England. Pp. 32. (London: H.M. Stationery Office.) 6d. net. [169

The White Paper on Educational Reconstruction and its Impact on Training for Mechanical Engineering. Pp. 8. (London: Institution of Mechanical Engineers.) [169

Handbook of the Scientific Instrument Manufacturers' Association of Great Britain, Ltd. Pp. 48+53. (London: Scientific Instrument Manufacturers' Association of Great Britain, Ltd.) [209

The Liverpool and Stoke-on-Trent Railway Hour Section and also Birmingham and Nottingham Hour Sections to speed up Railways in the Midlands. By J. F. Pownall. Pp. 12. (Birmingham: Cotterell and Co.) 1s. [209

Ministry of Agriculture and Fisheries. Growmore Bulletin No. 9: Orchard Spraying for Commercial Growers. By J. Turnbull. Pp. 14+2 plates. (London: H.M. Stationery Office.) 4d. net. [219

Other Countries

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 873: Surface Water Supply of the United States, 1939. Part 3: Ohio River Basin. Pp. xi+578+1 plate. 65 cents. Water-Supply Paper 875: Surface Water Supply of the United States, 1939. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. xi+406+1 plate. 50 cents. Water-Supply Paper 880: Surface Water Supply of the United States, 1939. Part 10: The Great Basin. Pp. vi+160+2 plates. 25 cents. Water-Supply Paper 900: Surface Water Supply of the United States, 1940. Part 10: The Great Basin. Pp. iv+126+1 plate. 20 cents. Water-Supply Paper 901: Surface Water Supply of the United States, 1940. Part 11: Pacific Slope Basins in California. Pp. viii+378+2 plates. 50 cents. Water-Supply Paper 902: Surface Water Supply of the United States, 1940. Part 12: Pacific Slope Basins in Washington and Upper Columbia River Basin. Pp. v+210+1 plate. 30 cents. Water-Supply Paper 903: Surface Water Supply of the United States, 1940. Part 13: Snake River Basin. Pp. vi+246+1 plate. 35 cents. Water-Supply Paper 904: Surface Water Supply of the United States, 1940. Part 14: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. v+208+1 plate. 30 cents. Water-Supply Paper 910: Water Levels and Artesian Pressure in Observation Wells in the United States in 1940. Part 5: Northwestern States. By O. E. Meinzer, L. K. Wenzel, and others. Pp. iii+184. 25 cents. (Washington, D.C.: Government Printing Office.) [128

War Department. Technical Manual TM. 10–420: Emergency Food Plants and Poisonous Plants of the Islands of the Pacific. By Dr. E. D. Merrill. Pp. v+149. (Washington, D.C.: Government Printing Office.) [178

Archæological Reconnaissance in Campeche, Quintana Rao, and Peten. By Karl Ruppert and John H. Denison, Jr. (Publication 543.) Pp. vii+230+75 plates. (Washington, D.C.: Carnegie Institution.) 4.25 dollars. [188

Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History. Vol. 8, Art. 4: Physiological Aspects of Spring Diatom Flowerings. By Gordon A. Riley. Pp. 54. (New Haven, Conn.: Yale University.) [188

Proceedings of the United States National Museum. Vol. 93, No. 3164: The Birds of Southern Veracruz, Mexico. By Alexander Wetmore. Pp. 215–340. (Washington, D.C.: Government Printing Office.) [238